SCIENTIFIC AMERICAN SUPPLEMENT. No. 1455

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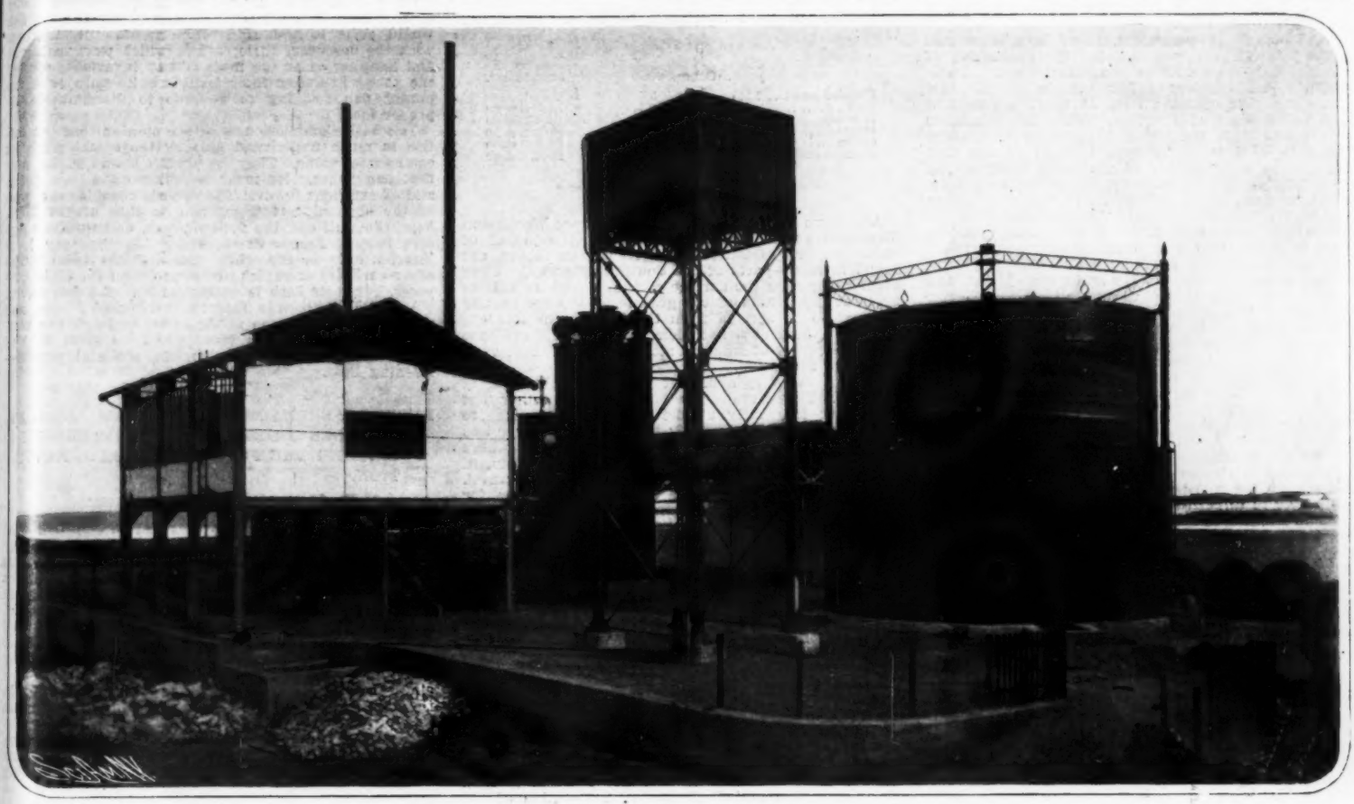
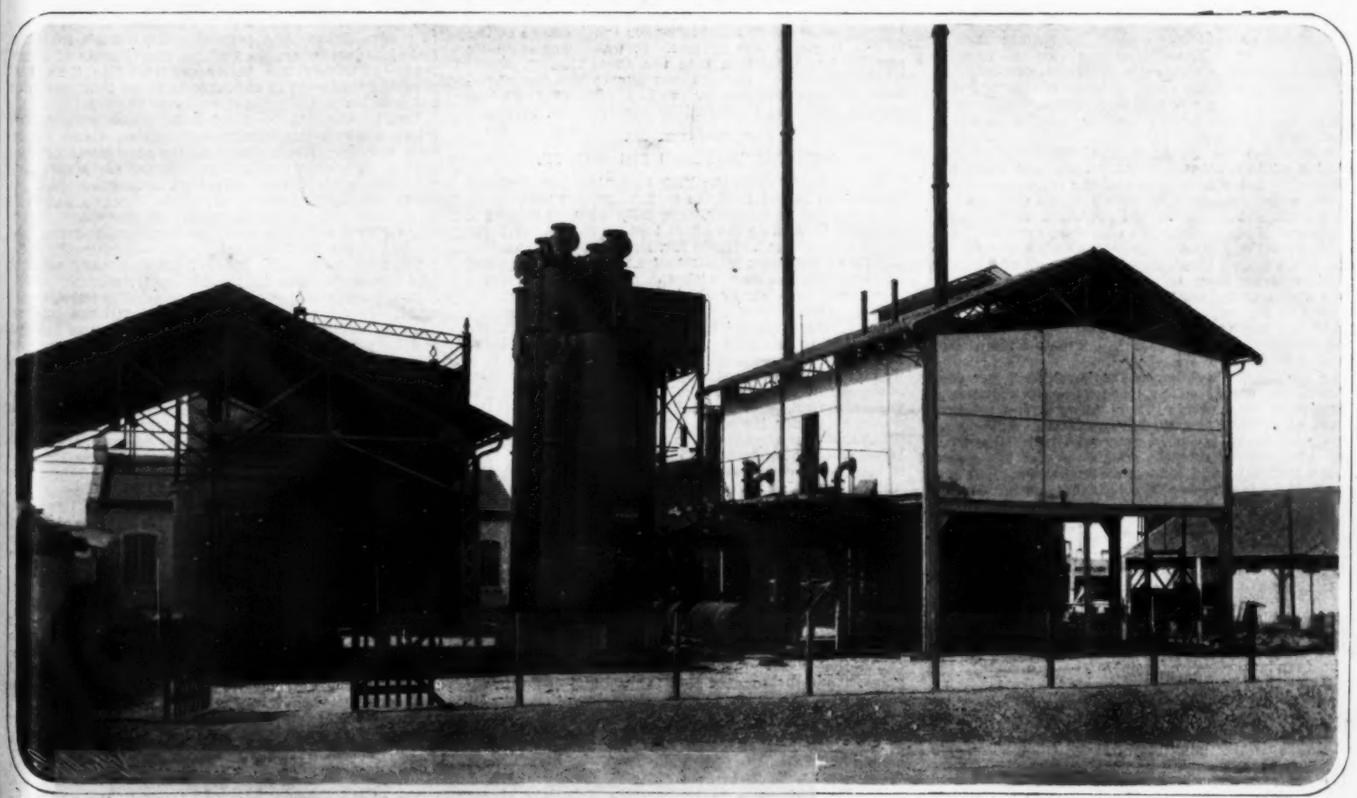
Scientific American, established 1845.
Scientific American Supplement, Vol. LVI. No. 1455. NEW YORK, NOVEMBER 21, 1903. Scientific American Supplement $5 a year.
Scientific American and Supplement, $7 a year.



THE ELECTRIC LIGHT PLANT OF THE CITY OF TUNIS.



THE PIERSON GAS GENERATOR OF THE TUNIS ELECTRIC LIGHT STATION.

THE ELECTRIC LIGHTING STATION OF TUNIS.*

By EMILE GUARINI.

THE central electric lighting station of Tunis is well worthy of description, since it is the first example of an electric light station established by a gas company and making use of coke-gas motors for running the electric generators. The motors employed are of the Crossley type. They can be run on either coal-gas or coke-gas, and can be changed from one fuel to the other without stopping. The efficiency varies according to the gas employed. When using coal-gas 96 electrical horse power can be obtained with 96 explosions a minute, and, with coke-gas, 77 electrical horse power per 64 explosions per minute. The power per explosion is therefore 20 per cent greater with coke-gas. The gas is delivered to the motors by two main conduits laid in a wide trench formed in front of them. The diameter of the coke-gas conduit is 16 inches, and that of the coal-gas one 10. Four of these motors, of 106 horse power each at the brake, drive four dynamos of 70 kilowatts each at 240 volts.

The Pierson gas generators, three in number and double jacketed, are supplied, for the production of coke-gas with coke derived from the works. Their maximum consumption is 2.86 pounds per kilowatt hour. The coke contains from 10 to 12 per cent of ashes and 4 per cent of water. Since the generators are supplied with coke, it was necessary to arrange them with a view to the easy removal of the slag. Each generator is capable of producing sufficient gas for developing 150 horse power. Besides the generators themselves, there are two small Hopwood boilers that have a working pressure of 85 pounds to the square inch, and are capable of furnishing sufficient steam to supply four generators. These are arranged above the generators, upon a special platform. The air and steam are led to the generator jacket and thence to the under side of the grate by a superheater consisting of two concentric tubes, the inner of which forms a radiator. It is through this inner tube that the gas produced in the generator passes, before it is led to the hydraulic main and thence to a condenser of large surface.

In addition to the parts already mentioned, the Pierson gas generator comprises a large coke pipe, two chemical purifiers of very great surface, and a gas tank having a capacity of 8,122 cubic feet.

A number of pressure gages indicate for the stokers the pressure in the generator, the condenser, the coke pipe, the purifier, and the gasometer. The approximate calorimetric value of the gas is controlled by a special Pierson calorimetric lantern. Round elbows have been avoided in the piping, which can be easily cleaned at any point by simply unscrewing a flanged cap.

The use of coke-gas motors in lieu of steam presents a triple advantage for a gas company establishing a central electric lighting plant. In the first place, it permits of regulating the stock of coke by utilizing coke-gas motors, when the stock on hand becomes too great, or coal-gas motors when it becomes insufficient. Again, in case of repairs to the gas generator, it permits of running without any supplementary expenses for illuminating gas. Finally, it permits of utilizing fuel that is ready at hand at the works, and of thus avoiding considerable expense.

It was owing to such advantages, established by the Messrs. Pierson, of Paris, that the Tunis Gas Company was led to make an installation which is giving entire satisfaction and which will probably soon be imitated elsewhere.

A GREAT CONCRETE ARCH IN GERMANY.

A REMARKABLE structure crosses the Neckar near its confluence with the River Glatt and near the town of Neckarhausen. The stream is subject to heavy floods and during such times rafts of large timber are sent down. The size of the span was determined by a reference to the highest known periods, records of which extend back to the year 1778.

Concrete was decided upon as the material of construction after a careful investigation into costs and methods. It is not even armored, and stands, probably, as the greatest exponent of purely monolithic work.

The foundations rest in beds of marl, traversed by thin layers of clay, which, on one side, have been displaced from their original positions and required, because of the danger of sliding, that the mass of masonry should be larger than was otherwise necessary.

The radius of the soffit is about 300 feet, the greatest yet used in any unarmored concrete arch, and the flatness of the structure is therefore striking. The span, from center to center of pins, is 164 feet, with a total rise of only 15 feet.

The roadway, which has a gradient of 1½ per cent on each side of the center, rising toward the crown, is supported on concrete pillars forming a subsidiary system of arches through the spandrels. This is an entirely novel conception in concrete work of this character, and accomplishes the double purpose of lightening the structure and adding to its beauty. The latter consideration is one which is almost universally observed in European structures, even of the most utilitarian character, but with us is too apt to be lost sight of.

The hinges at the crown are composed of eight pairs and those at the ends of nine pairs of shoes each. These shoes are all of the same size, 2 feet 5¾ inches by 1 foot 7¾ inches on the base, with a depth of 1 foot 3¾ inches, and bear upon steel rollers about 4 inches in diameter. A slip joint is also provided at each end of the bridge.

The foundations were begun in the autumn of 1899 and were made by means of uncovered caissons, which were pumped out at the rate of about 500 gallons per minute. The concrete, which is of gravel in the foundations, was placed in layers from 4 to 6 inches in depth. The daily quantities varied from 60 to 100 cubic yards.

The centers rest upon piles and were installed with the idea of being able to "strike" them in the easiest way. For this purpose and to provide for any sinking of the piles during construction, the piles were capped with screwjacks, resting upon and bearing continuous tie timbers, the upper one of which was recessed to receive the screw.

The concreting of the arch-ring was carried on in equal proportions on each side of the transverse axis in order that the pressures on the false work might increase equally. The surfaces and ornamentation were carried on with the main body of the work in forms of planed wood, which was oiled on the inner side. These portions of the work were variously colored by imitating sandstones of different colors in the cement with which the concrete was mixed. The arch proper contains 350 cubic yards, and this was placed in nine days. Following this, the pillars, subsidiary arches, roadway and ornamentation were carried on.

The striking of the centers took place about two months after the commencement of the arch-ring.

The cost of the whole work, including studies and plans, amounted to about $17,600, and the quantities and mixtures were as shown in the accompanying table:

	Cubic yards.	Composition parts. Cement.	Sand		Gravel or broken stone.
Foundations	1,160	1	3	6	Gravel
Arch	350	1	2.5	5	Broken stone
Roadway	95	1	2.5	5	Broken stone
Pillars	215	1	3	6	Broken stone
Crown	34	1	4	6	Broken stone
Artificial stone	80	1	2	4	Broken stone

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

SARSEN STONES.

ACCORDING to a paper read by Mr. Horace Woollaston Monckton at the British Association, the blocks of sandstone or quartzite, known as Sarsen stones, are found in many parts of the South of England. They occur at or near the surface of the ground as well as in or at the bottom of the gravels. They are usually believed to be derived from the Bagshot or Reading beds, but there does not seem to be definite evidence of the discovery of a Sarsen stone *in situ* in these or in any other formation.

Sarsens are very abundant in the neighborhood of Bagshot. They have been observed by the author first and most frequently at the bottom of or close to the bottom of beds of gravel; secondly, and rather less often, at or near the surface of the ground where there is no gravel; and, thirdly, but only seldom, in gravel, some height above the bottom of the gravel. The author has never seen a Sarsen stone *in situ*, for though he has seen many partially uncovered stones, they have in every case shown signs of wear by either water or weather. At the same time, he has noticed that the corners are frequently angular, and many of the stones have been very slightly worn and certainly not rolled by water currents or streams. The country around Bagshot is formed of the Bagshot beds, largely of Upper Bagshot beds, which are shown by their fossils to be of Lower Barton age, and the author suggests that soon after their deposition this part of England rose somewhat above sea-level, and remained as a wide, fairly level, and low-lying flat covered with marsh and vegetation for a very long period. The Sarsen stones are, he believes, indurated portions of this old land surface. If this is correct it accounts for all the above-mentioned facts and also for the presence of numerous rootlet tubes in the stones, and for the absence of marine shells or of casts thereof. If after a long period of repose an elevation of the land took place, the streams would rapidly cut channels in the sandy soil and leave the indurated fragments of the old surface scattered about at various levels, and many of these would become buried in the beds of gravel, thus accounting for the presence of the Sarsen stones in the gravels. It was suggested long ago by Mr. Hudleston that the concretionary action which formed the Sarsens was due to the decomposition of vegetable matter, and a somewhat similar opinion has been expressed by the Rev. Dr. Irving.

THE CATFISH AND ITS HABITS.

GEORGE M. BOWERS, the Fish Commissioner, declares in a recent report that the catfish has not been given the attention it deserves, especially when the amount of space devoted to the black bass or the wily pike is taken into account. These Mr. Bowers was inclined to regard as the most intellectual fish until he acquired a closer acquaintance with the catfish through some investigations made by Prof. Kendall of his staff.

The catfish abhors running water. It likes to find a pond with a muddy bottom on which it can repose after having satisfied its ravenous appetite. Prof. Kendall says the appetite of an ordinary catfish is a wonder. It eats incessantly day and night, prowling along the bottom of the pond or river with its barbels widely spread, searching the mud beneath and the water above for its prey. It is not fastidious. Anything from an angleworm to a piece of tomato can is bolted with the greatest relish. In the search of food it displays great strategic ability. Prof. Kendall has watched catfish carefully select a spot where the mud is the same color as their dark skin, bury their yellow stomachs in the mud with only barbels and dusky forehead exposed, and then wait for hours for the unwary prey. When it comes along out darts the catfish, and that is the end of his victim. This fact alone, the Fish Commission experts declare, is enough to show that the cat is a very intellectual fish.

But there are other reasons for boasting of his brain power. The experts say that the species is easily tamed, and can be trained like pigs. When it is recalled that there are several troops of educated pigs going about the country this is no small compliment. The catfish knows the law of self-preservation as well as any other of the finny tribe. If the water becomes warm in summer, he survives because he knows how to make the best of a bad situation. Should the air supply in the water fail the catfish, instead of turning up on his back, will set about taking care of himself. He will come to the surface, leisurely renew the air in his swim-bladder, and even, frog-like or turtle-like, swallow air in bulk, trusting to stomach respiration.

Should the pond go entirely dry, the catfish will seek out some comfortable crack in the mud and lie dormant for days or weeks until the pond fills up again. He is a great lover of home, and when once comfortably settled in a pond will move only on extraordinary inducements. When the spring freshets come the catfish does not permit himself to be washed out of home, as most other fishes do, for he buries himself in the mud, and if the flood dislodges him it only does so by carrying away the bottom of the pond. After such a catastrophe he hunts up a new abode, even gives up his all-commanding habit of eating until he is situated again to his liking.

The catfish takes exceptionally good care of his family. Both the male and the female watch over the little ones, and Prof. Kendall was agreeably surprised to find that the predaceous feeding habits of the old fish do not go so far as to permit it to eat its own young as do bass and other more highly esteemed fish. Mr. Kendall in watching a pair of old catfish raise their young discovered that when he threw pieces of beef liver into the pond for the young the old fish would seize it and apparently swallow it, together with the dozens of little catfish, which were eating at and hanging on to the meat. They invariably ejected the young fish from their mouths quite uninjured, the parent fish seeming to be able to discriminate its proper food.

The Fish Commission is of the opinion that the catfish is much underrated also by those who gage its commercial value. They say that it is one of the very best pan fishes. Its meat is white, crisp, and juicy, and of excellent flavor. The experts consider the flesh of the channel catfish superior to that of the black bass, the wall eye, the yellow perch, or any other percoid fishes. Among fresh water fish they say it is inferior only to the white fish and the trout. The other varieties of catfish are not so good for table purposes, but their flesh is nutritious and of a fair flavor.

Prof. Kendall calls this the poor man's fish, and predicts that when the public comes to know the merits of the catfish better there will be a great deal of money made by raising them in artificial ponds.—Evening Post.

RECENT AERONAUTICAL PROGRESS, AND DEDUCTIONS TO BE DRAWN THEREFROM, REGARDING THE FUTURE OF AERIAL NAVIGATION.*

By MAJOR B. F. S. BADEN-POWELL.

IT is with feelings of the greatest satisfaction that I am now able for the first time to address the society in the capacity of its president, and I must seize this opportunity of expressing to you my heartfelt thanks for the very great honor which you have conferred upon me by electing me to this position. I can not but feel that my labors in the past, though varied and dipping into almost every branch of aeronautics, have not been so extensive or so prominent as to warrant my selection for this important post, but nevertheless I sincerely hope that, with freer opportunities, I may, in the immediate future, be able to accomplish much more in the work we have before us.

My absence from England during the last three years, on active service in South Africa, has prevented my fulfilling many important duties for the society during a period of unusual activity and importance, but on the other hand, the time I have spent on the "trackless veldt," and in the monotony of camp life, has not, I hope, been wasted, as ample opportunity has been afforded for careful meditation and consideration of the whole subject which it is the object of this society to study. I therefore propose not so much to give a technical lecture on the various experiments of recent years—you have had better opportunities than I of studying these—as to endeavor to make clear our present position.

During these three years many great events have taken place in the aeronautical world. Count Zeppelin's monster airship, built on sound scientific principles, of enormous size and quite different in design to anything made before, has been completed, and has made successful ascents, although, I much regret to have to add, it has not succeeded in traveling through the air at a sufficient speed to warrant its being considered a practical success.

Then we come to M. Santos-Dumont's many more or less successful trips in his navigable balloons, which, if not demonstrating any new principles have shown what perseverance and attention to detail can achieve. Though we have learned some useful practical lessons, and have been given data of great value for future experimenting, unfortunately the actual results attained carry us so little beyond what was accomplished twenty years before by MM. Renard and Krebs, that one begins to think whether we have not nearly reached the end of the tether as regards the propulsion of balloons.

The unfortunate calamities to M. Severo's, and, more recently, to M. de Bradsky's balloons, as well as the absolute failure of M. Roze and others, only tend to confirm this growing opinion. The latest accounts of M. Lebaudy's balloon seem to make out that it has accomplished more, but we must await the results of more prolonged trials before we can come to any decision. Mr. Stanley Spencer's trip over London in a navigable balloon, though it proved nothing as regards the dirigibility or inherent speed of the machine, attracted some interest in the matter.

Besides these we have heard of various experiments with flying machines proper. Herr Kress is said to have risen off the surface of the water, but owing to some mismanagement the machine turned downward and fell in the water again. In Australia, Mr. Hargrave has constructed a large machine. In America, Mr. Wilbur Wright and his brother have been making wonderful progress with gliding machines, and Prof. Langley has been hard at work constructing a large new machine. He informed me the other day that in a very short time we might expect to hear something of this—something big. It might, he added, be

* Presidential address before the Aeronautical Society of Great Britain.

a big smash! But he wisely intends trying it over water.

Then, too, like the invisible universe of dark stars that Sir Robert Ball talks about as being possibly more extensive than that of those seen, there are probably more inventions being worked at in private than we ever hear of publicly, and many of them are doubtless of great importance. It is only recently that the results have been published of the valuable experiments with aerial-screw propellers which Mr. W. G. Walker conducted for Mr. Alexander.

Another sign of progress in the subject of aeronautics during the last few years has been the establishment in England of two more public bodies, the Aero Club and the Aeronautical Institute, the former having been established for the encouragement of ballooning (and possibly flying) as a sport, while the latter aims at interesting the working classes in the subject.

I may here seize the opportunity of explaining to our visitors and others the objects of our society, and why it is that we make so much of a study which to them may seem somewhat chimerical and of no very special merit, and by explaining these I hope to enlist their sympathy and support to the movement. For I have before now been asked: "Why should it be necessary to have a society for the study of aerial navigation? Where is the importance of it? Why not institute a society for submarine navigation, for wireless telegraphy, or for the encouragement of any other novel invention for the improvement of means of communication or warfare?" But useful as many such inventions may be, none can have the great importance which may some day be attached to the machine which navigates the air.

And there are two reasons why this subject is a large one. The first is that the science of aeronautics is one combining many branches, and spreads into many ramifications. We have aerial machines as they exist to-day. The balloon, forming a unique and fascinating mode of travel, enables us to mount high into the skies to obtain glorious views of earth and cloudscape, giving us a laboratory for the study of many intricate problems of the atmosphere, and forming a valuable instrument of war. We must study how this passive buoy may be improved upon, what new materials may be applied to its construction, gases, methods for causing it to rise and sink, and means of directing it out of the course of the wind. But we also have the more difficult problem of how to drive it through the air so as to make it independent of the wind and make it go in any desired direction. Closely connected with this is the subject of kite flying, whether for man lifting or meteorological observation, of parachutes, and of soaring machines. All these necessitate a certain knowledge of the various branches of meteorology, which is to aeronautics as hydrography is to marine navigation. Then we have the study of birds and other flying animals as a natural sequel to the science.

The second reason for the importance of this subject is the vast future which appears open to it. If such an apparatus can be constructed as will enable man to make practical use of the highway of the air, there is promise of the subject becoming of even more importance than marine navigation or railways.

We have, then, not merely to consider the broad principles of the general form of the aerial machine of the future—whether it is to take the shape of an artificial bird, a propelled kite, or a dirigible balloon. We have to study the subject of aerodynamics, the effect of air pressures on plane or curved surfaces traveling at various speeds and at various angles of incidence. We have to investigate the efficiency of aerial propellers of different forms, the strengths of materials, the energy and weights of various forms of motors. Then we must also study the natural currents of air, the variability of air strata, the trends of winds, and so on.

The great range of subjects to be gone into by our society is thus patent. Many of our members and others are busily at work in some particular groove, making steady progress in building up their portion of the foundation of that great structure which we all hope to see rise up in the future.

But to return to the question of the recent progress in aerial navigation, I will now endeavor to point out and explain the present position we hold, and, by considering the state of the subject as it at present exists, to judge whether or not there is any real probability of our attaining that great goal which most of us look forward to.

Though it is improbable there are many here present to-night who do not look forward with feelings of confidence that artificial flight will some day be accomplished, yet there are still some few skeptics (most, if not all, of whom have never looked deeply into the subject) who believe it impossible. For this reason it may not perhaps be out of place in such an address as this to point out our reasons for maintaining this belief.

The first great argument in favor of it is that birds fly. If we had never seen such a thing as a bird, many of us might reasonably argue the thing to be impossible. But there they are. Not only can they rise in the air, not only progress at a very rapid rate through it, but they can continue the movement for long periods and in almost any weather. It is quite certain now that birds do not possess any very extraordinary power; but if they did we could probably "go one better" with the modern very compact and light oil engines. We have now compressed the strength of a horse into a little motor weighing no more than a large bird. There is the power. Can it be applied? Many people have argued that the flight of a bird is dependent on some valvular action of its feathers. Let it be so; but how do you account for the flight of the bat and of the flying fox? Others have thought that flight is only possible up to a certain weight, maintaining that the ostrich and emu are beyond that limit. But geologists will point you out the fossil remains of a huge reptile which they declare flew in the air and weighed far more.

But, leaving nature, we may consider what has been done by man to justify our hopes.

Though I believe it may be said that nearly all the authorities on the subject are now of opinion that the balloon cannot be considered as much more than an aid—to act as a stepping stone—to true flight, yet there are many workers who consider that very much may be accomplished by propelled balloons. Some authorities have calculated that a speed of 44 miles an hour might be practically attained, but not more.

M. Santos-Dumont and others have shown us what can be done with a little cigar-shaped balloon. They have clearly demonstrated the difficulties to be overcome. It is very palpable that the surface of such a balloon must be stiff and rigid. Once it gets flabby it cannot be propelled—the skin will vibrate and add to the resistance; the nose, unless distended by framework, will be driven in and offer great resistance; the gas will be driven back toward the after end, and the balance be disturbed. To preserve this necessary rigidity, all the earlier navigable balloons were kept taut by means of the ballonet, but Count Zeppelin effected this by an internal framework.

Count Zeppelin, as I have said, struck out a new line. By greatly increasing the size of the balloon, he had obtained so much more lifting power as to be able to add a complete framework that stiffened it. But it was probably solely owing to this great size that the apparatus failed to be practically manageable. It may be compared to the "Great Eastern" steamship, but with the difference that at the time of its construction we had but the most elementary experience of air vessels propelled by engines. At the same time this enormous capacity had its advantages. Had it been of half the diameter and half the length, though the resistance to propulsion might have been only one-quarter, the volume and the lifting power would only have been one-eighth. So that, instead of carrying engines of 32 horse power, as was done, it might have only been possible to carry some 4 horse power. Dr. Pole, in his most valuable little treatises, years ago pointed out the advantages of very large volume.

One result, then, of recent experiments is that it seems quite practicable to build a navigable balloon to go, we will say, 15 miles an hour. This, however, is not quite enough. As the wind so often blows faster than this, it is unsafe to let the balloon out on any but a very calm day; else, though only blowing 16 miles an hour, the machine will inevitably be carried off and have to descend in strange fields far from its shed, and the difficulties of transporting it back may be so great that it may even have to be taken to pieces. Having successfully accomplished this much, however, it certainly looks as if we could improve a little and get the balloon to travel 20 or 25 miles an hour, which would be sufficient to stem the ordinary light breezes.

We have learned many practical lessons from these recent experiences. It is necessary to make efficient provision against the balloon caving in or buckling up. It is, of course, most important that the engine shall be so constructed as not by any possible means to be able to ignite the gas in the balloon. But especially we have learned that—speaking in general terms—for a cigar-shaped vessel some 20 feet in diameter, it is necessary to apply a power of more than 16 horse power (presuming no exceptionally efficient propeller be found) for it to be really efficient. This practically means that you must have a larger balloon.

MM. Lebaudy have now adopted a large balloon, enabling them to carry an engine of 40 horse power, or more than double the power of that of M. Santos-Dumont. Colonel Renard, also, is about to build one larger still, of some 90,000 cubic feet. Dr. Barton's proposed airship is also designed to be of great size.

Passing from the balloon—that is to say, any apparatus which displaces a volume of air weighing as much or more than its own weight (and many thoughtless inventors are apt to neglect this definition)—we find several different types of machines which show promise of success.

Beginning with the simplest, we have the gliding or soaring machine. One of the greatest paradoxes in nature is soaring flight. I have said how doubtful many people might be about aerial navigation if they had never seen a bird fly, but we can confidently assert that no man would believe it possible for a bird to maintain itself for hour after hour in mid-air without the slightest movement of its wings were the actual demonstration of it not visible every day. I will not now enter on a discussion as to how this is accomplished, but will only say that there are inventors who hope to be able to emulate the albatross and soar away into the heavens without any motive power or propeller. It seems so paradoxical that many laugh the idea away. But the hard fact remains that birds can do it, and therefore why not men? I received a letter only a few days ago from Mr. O. Chanute, than whom there is probably no greater authority living on soaring flight. He says that he had just returned from witnessing this season's gliding experiments of the Brothers Wright, and that "they have made a very considerable advance since last year, and now glide at angles of 6 deg. to 7 deg., sustaining 125 to 160 pounds per net horse power. Wright is now doing nearly as well as the vulture, is not far from soaring flight, and I am changing my views as to the advisability of applying a motor."

I think this is a most remarkable statement, and there really seems no reason why such experts, having attained proficiency in the delicate art of balancing themselves according to the various puffs and currents of air, should not be able to soar away on the wings of the wind and remain indefinitely in mid-air.

The next general type of apparatus that I may refer to is that of rising in the air by means of a screw propeller mounted on a vertical shaft. We all have seen little toys ascend in the air working on this principle. A large machine of this sort was recently constructed in Paris, but the experiments of Mr. W. G. Walker, of carefully testing the thrust and lifting power of various screws, have been among the most important contributions to this science. He has clearly shown that it is possible to practically obtain a thrust of 25 pounds per horse power. As engines are now made weighing no more than 10 pounds per horse power, it is clearly demonstrable that a machine on this principle could be constructed to lift itself, carrying some 15 pounds per horse power over and above the weight of the engines. Even if not a practical form of machine for traveling through the air, it would be a most interesting experiment to try.

Finally we come to that variety of aerial machine which has been adopted by most inventors and which seems to promise the most satisfactory results. I mean what is known as the aeroplane. Sir Hiram Maxim brought this prominently forward many years ago, and both he and Prof. Langley have proved theoretically that it is the most economical form of apparatus; that is to say, that a given weight can be supported with less engine power than by other methods.

Great progress has also been achieved in recent years in this line. Lilienthal pointed out the greater efficiency of curved surfaces as compared to flat ones. Phillips and Hargrave experimented further with aerocurves. Considering how much more we know about the subject now than when Maxim first built his machine, it looks as though we might really hear of great results shortly from America or Australia.

Our present position is, then, a hopeful one. Balloons have been gradually improved until we can practically rely on building one to go 15 miles an hour and probably more. Large flying machines, giving practical experience of their construction, have been built. Good-sized models have flown well through the air. Gliding machines, balanced and controlled by human effort, have been maintained in the air for considerable periods and have descended at very gradual angles. And, what is of the greatest importance, small engines, giving great power for their weight, have steadily improved year by year, leaving but little for us to desire in this respect.

All that we require, then, to attain practical flight, is to make a machine only slightly better than those already in existence. To accomplish this all that is required is a certain amount of skill and a good deal of money.

There has often been a lot of wild speculation about what might happen when flying machines are introduced into everyday life, but it may be worth while considering for one moment what is likely to result, so as to judge whether the matter is one really demanding an effort to accomplish; whether, in fact, "the game is worth the candle."

Whatever the exact form the apparatus may take, we may assume that it will possess certain characteristics. The first of these is that it will travel very fast. There are several reasons for supposing this. Not only must it be able to stem ordinary light breezes, but, to be really useful, it should be capable of going against any ordinary wind, and to do this at any useful speed implies a rate of 40 or 50 miles an hour. Then, high speeds are economical in aerial machines. Langley, by his elaborate experiments, has shown that the faster our aeroplane is propelled through the air, the less force in proportion is required to sustain it. Again, the airship, unlike its prototype on the water, is not impeded by skin friction, so that the power required to drive it at high speeds does not increase in the same proportion. A bullet can be propelled through the air at immense speed, but if it enters the water its way is soon stopped. One more reason why we may hope for greater speeds than are usual in traveling on land and sea is, that in the latter pace must be kept within bounds for fear of collision, both with other conveyances and also with irregularities (whether in rails, embankments, and ridges, or rocks and sand banks) which may exist beside the track.

In the aerial highway we have greater latitude. We have height as well as length and breadth. We can choose our particular altitude and stratum to travel in, so that perhaps 1,000 machines could cross over the same spot at the same time without colliding. In fact, it would decrease the chance of collision by a thousandfold, in addition to the lateral route not being so circumscribed. There are no police traps up there.

Taking into consideration the speed at which birds travel, that at which models have been flown, and the theoretical calculations which have been made, we may reasonably suppose that 100 miles an hour will be no excessive speed for a flying machine.

Those who think this estimate oversanguine may ponder over an extract I recently came across from an old newspaper published seventy-eight years ago, referring to the railway then about to be constructed from London to Woolwich. In this reference is made to the possibility of the train's being able to attain the terrific speed of 18 to 20 miles an hour; but it concludes, with sarcastic incredulity, "We should as soon expect the people of Woolwich to be fired off on one of Congreve's rockets as to trust themselves to the mercy of such a machine going at such a rate."

Once a practical flying machine existed, the uses to which it might be applied are varied and important.

Primarily it would form an incalculably valuable engine of war. One can scarcely imagine any invention which could have a greater effect on the conduct of warfare.

We can now appreciate much more than we could three years ago of what vast importance such a machine would be. It is worth dreaming for a moment to realize what might have happened had we, in 1899, had some machine capable of traveling rapidly through the air. First of all, for mere reconnoitering, how much could have been done! In Natal, on the outbreak of war, such a vessel, ascending at Ladysmith, could have cruised around up to Laing's Neck, noting every Boer and every gun within, say, 5 miles of the track passed over, taking a turn round along the frontier, and have been back to report within a few hours. We would then, at "one fell swoop," have had certain, reliable, and full information of what was doing, instead of going on mere rumors and the vague observations of a few scouts. Another machine at Orange River could have moved forward, noted the position of the enemy at Belmont, Modder River, and Magersfontein, could have gone into besieged Kimberley and heard their news, and could have run back to report to Lord Methuen. I need not repeat the many instances that occur to me of the extreme value of such an apparatus for reconnoissance. We might really say that none of those awkward reverses which we suffered in the early part of the war would have occurred had we known the exact whereabouts of the enemy. Latterly, how easily the evasive commanders could have been located and followed up. Reconnoissance by captive balloon

may be considered dangerous, but an apparatus traveling 150 feet a second runs an infinitely smaller chance of being hit by projectiles. If the dropping of explosives on the heads of an enemy is not now considered "fair play" (though it is difficult to see why this should be less humane than throwing lyddite shells from a howitzer), yet there are many more uses to which the aerial fighter might be put.

He could blow up the railway lines and bridges, even if he had to descend to do so. He could cut all the telegraph wires in the country, and could set light to stores and do other damage. A machine soaring about over a town or camp occupied by the enemy would certainly have a very decided moral effect on him. Communication could be kept up with, and even, perhaps, a few stores might be introduced into a besieged place.

I need not go further into the possibilities of the future. The more we think the matter over the more can we realize the extraordinary effect such an innovation would produce in war. I do not think anyone would deny that, had we been in possession of such apparatus during the late war, the operations would have been so greatly facilitated that the campaign would have been ended in a comparatively short time, and that we should have been saved an expenditure of many millions of pounds.

Even in naval warfare, if such speeds as I have mentioned were possible, the aerial machine should prove of infinitely more value than a submarine or a torpedo boat. If the invention of the Brennan torpedo was considered worth £110 000, how much more would be the value of a dirigible aerial torpedo!

Another important purpose to which flying machines could be applied would be for the exploration of unknown lands. With a rapidly traveling apparatus, the North Pole could be reached in a few hours. From the north of Norway it is about 1,300 miles to the pole. It would then be almost possible to go there and back in twenty-four hours. When we think of the large sums which have been devoted to arctic and antarctic explorations, and remember that very possibly a tenth of this amount might produce a machine capable of thoroughly exploring both these regions in a few weeks, it seems really worth considering whether such money is not wasted. The trackless deserts of Asia and Africa could be traversed and retraversed, the mysteries of Mecca and of Lassa laid at our feet.

But over and above these most important and far-reaching possibilities of aerial navigation, there is the likelihood of a revolution in our ordinary modes of travel by one infinitely more rapid, cheap, and convenient. I have already given my reason for supposing that such a means of travel would be rapid. There is also good reason for supposing it would be economical. No rails or permanent way need be laid on the billows of the clouds. No roads need be constructed or kept in order through the realms of blue. Even expensive harbors, dredged channels, lighthouses, and beacons need not be maintained by the owners of airships. Going from place to place "as the crow flies" shortens the route and adds to the economy. The convenience of the system is also evident. Already we are beginning to appreciate the value of the motor car going from door to door instead of our having to get to the train at a fixed moment. But when we can order round our aerial motor to take us straight to our destination, passing equally well over land or water, towns or cornfields, independent of traffic and roads, then only shall we realize what real convenience of travel is.

Speed, economy, and convenience are big factors in a new mode of travel.

But there is one consideration which I believe is greatly responsible for the tardiness with which this subject progresses. Perils and dangers loom before us as a skeleton contaminating and haunting our castle in the air. The mere idea of being poised high up in the sky, and of falling from the machine through thousands of feet to Mother Earth, is so terrible to contemplate. But the aeronaut of to-day soon gets accustomed to being at a giddy height, and without doubt the people of to-morrow will have no qualms. Imagine the feelings of the savage who for the first time sees an express train rush through a station at 60 miles an hour, banging and clattering with fiendish uproar, shaking the very ground, and darting along at a speed incomparable to anything he has ever seen before. Would he trust himself to travel by that means? Though to flit through the air with the speed of a swallow may seem highly dangerous to our inexperienced minds, how often do we see a bird fall headlong to the ground?

What we see, then, looming in the future, more or less near, according to the energies of, and the encouragement we give to, those pushing the matter forward, is the introduction of a new invention forming an invaluable and all-powerful weapon of war, an important aid to science and the practical knowledge of our globe, and a speedy, economical, and pleasant mode of getting from place to place such as will probably completely revolutionize our present methods of travel. Is this to be hastened and encouraged? If so, how can we help to further the cause? Like most matters in this world, what is most wanted is money. Many clever inventors and engineers are quite ready with their plans, but have not the means to complete them. We see millions of pounds spent on equipment for war. Hundreds of thousands devoted to the building of small warships. We see thousands subscribed for geographical exploration. But for the encouragement of that invention which may be paramount over all these, we see practically nothing devoted. When I say "practically nothing" I am not forgetful of a certain few who have devoted much to this cause. We do not forget the very generous donations which Mr. Alexander has given to this society, nor the valuable time and energy which our worthy secretary has devoted so gratuitously to further the objects of the society. Others, too, are helping as best they can with limited time and money; but what we would like to see would be a real solid fund built up, such as would enable us to get really useful work done. Then I feel sure it would not be long before the British nation would owe a debt of gratitude to the Aeronautical Society of Great Britain.

[Continued from SUPPLEMENT No. 1454, page 23301.]

TANGENTIAL WATERWHEEL EFFICIENCIES.*

BEING AN EXPERIMENTAL INVESTIGATION OF THE RELATIVE VALUES OF DIFFERENT BUCKET SHAPES.

By GEORGE J. HENRY, JR., Member A. S. M. E., Associate Member A. I. E. E.

SOME wheel builders state that if the bucket has any front in line with the stream, this "slaps" or "pushes" a portion of the stream out of the way and accordingly reduces the efficiency by this amount of lost stream. This is not the case by any means, as far as the design of Pelton bucket is concerned, but on the contrary, the stream enters perfectly and entirely without disturbance. In a bucket with a front wall, and properly designed throughout, the solidity of the stream is not interfered with, even to the slightest extent, until impact commences on the central interior dividing knife. All buckets which show wear and have been properly set and operated confirm this, as no wear occurs on the exterior of the front wall. The bucket here illustrated, although worn out on the inside, is clean on the front wall and back.

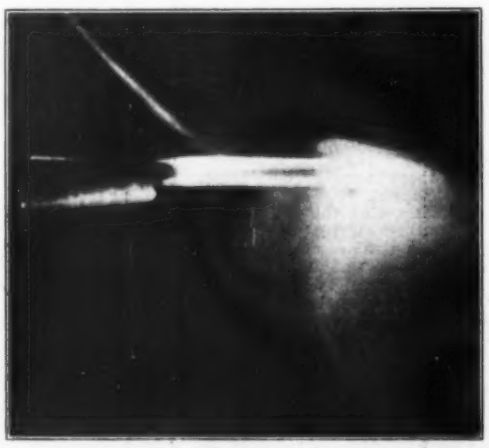


FIG. 10.—TANGENTIAL WATERWHEEL FITTED WITH PELTON BUCKETS.

Showing the discharge at almost zero velocity (the individual slow moving drops of discharging water are observable) and that the shape of the jet is maintained until impact in the center of the bucket, where the entire energy is removed from the water by the bucket, resulting in maximum efficiency.

Another fallacy shared in by many engineers is the misstatement that a bucket without a front wall cuts the stream in but one place. Nothing could be further from the truth. Every bucket with a dividing wedge splits the stream in two places, one of these being the plane of rotation through the central wedge, and the other containing the boundary line of the bucket and being parallel with the stream axis. The stream is thus divided into three parts at the intersection of the two planes, as shown in Figs. 6 and 8, illustrating the ellipsoidal bucket.

Any bucket having a central dividing wedge divides the stream into two planes, whether the bucket has a front wall or not. There are no exceptions to this rule, and, by the very nature of things, it is impossible for a bucket to enter the stream without cutting the stream with the front or bottom surface parallel with the shaft. This double plane division occurs in the buckets of the Pelton, Risdon, Dodd, Hug, DeReymer, ellipsoidal, and Berry, and the more nearly the stream (in both divisions) is taken up in the line of flow, the better the efficiency that will be obtained.

With buckets of the Berry and ellipsoidal types, a large percentage of the water entering each bucket strikes a comparatively flat portion of the bucket. If we bear in mind that the efficiency of a flat surface running under the same conditions is theoretically only fifty per cent, and practically much less, than when received on the wedge, we readily see that this loss, due to part of the stream striking on a flat surface, drags down the efficiency that would be obtained if the bucket were provided with a curved front surface or entering lip.

FIG. 8.—ELLIPSOIDAL BUCKET, SHOWING THE STREAM DIVISION IN TWO PLANES AND THE "NODES" IN THE DISCHARGE WATER LIKE A STRING IN VIBRATION INSTEAD OF A THIN FAN-LIKE DISCHARGE.

FIG. 9.—ELLIPSOIDAL BUCKET SHOWING THE TWIST IN THE DISCHARGE AND THE LEAKAGE OF PRESSURE WATER THROUGH THE FRONT, EVEN THOUGH STREAM HAS FIRST FULLY ENTERED THE BUCKET CAVITIES.

FIG. 11.—PELTON BUCKET, SHOWING PARALLEL DISCHARGE FROM BUCKET SIDES.

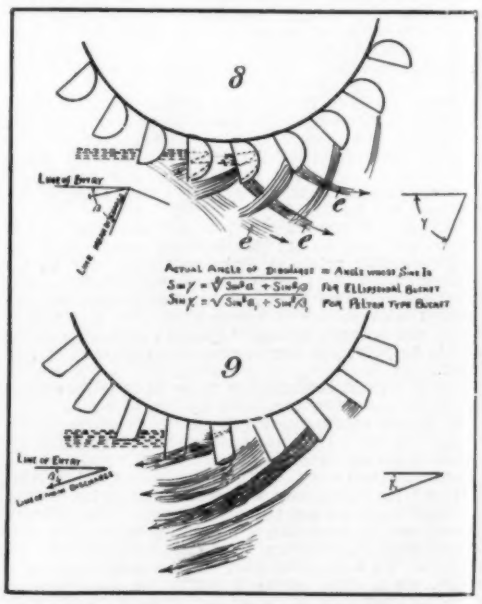


FIG. 12.—DIAGRAM SHOWING THE PATH OF DISCHARGE FROM THE ELLIPSOIDAL BUCKET (8) AND FROM THE PELTON BUCKET (9).

In regard to the division of the water jet in two planes: Consider for a moment any bucket in a position where the stream is partly entering it and the remaining portion of the stream passing on to the bucket next ahead; then that portion which enters the first bucket has been divided by one plane, namely, that passing through the bucket front line; furthermore, in the bucket, division has again occurred on the central

* A paper read before the Pacific Coast Electric Transmission Association at San Rafael, Cal., June 16, 1903. Copyrighted, 1903, by George J. Henry, Jr.

wedge, thus causing the water to be split into three parts by two planes. The accompanying photograph (Fig. 8) is of an ellipsoidal bucket in which the patentee claims this does not occur and where the three sections by two planes are clearly shown. (See also Fig. 9.)

We do not see how anything would be gained in the way of efficiency if the division into three parts could be avoided, as has been erroneously claimed by the inventor of the ellipsoidal bucket. The entry of the bucket front line into the stream, if properly made, can be the cause of but an infinitesimal amount of power loss, if any, which we are by no means prepared to admit. In fact, a bucket to give anywhere near a proper efficiency, in addition to the reason given above, must have a considerable front wall. Otherwise, after

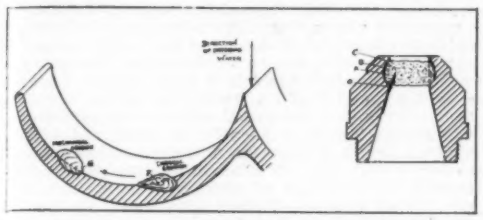


FIG. 13.—SHOWING CHEMICAL AND MECHANICAL EROSION ORIGINATING AT POINTS *F* AND *G* RESPECTIVELY, AND IN THE NOZZLE TIP, WHICH IS A SCALE DRAWING FROM A TIP ERODED IN ACTUAL OPERATION, AND THE CHEMICAL EROSION OF WHICH ORIGINATED AT *A*.

impact has occurred on the bucket surface, the jet will spread, and a large percentage of it finds its way out, without having given up more than a small part of its velocity, and therefore its energy. This is not only so during entry, but during the entire passage of the bucket through the stream, and, paradoxical as it may seem, it is a fact, that a greater disturbance in the stream, as far as those conditions which should be maintained for maximum efficiency are concerned, is caused by cutting down the height of the front wall below the splitting wedge, than by leaving it well up. This is not a theory or mathematical deduction, but a readily demonstrable fact which any interested parties may very easily prove.

There is another branch of this subject which is of considerable interest, and one, if carefully studied, that leads us to very important conclusions, viz., the erosion or bucket wear which occurs in every plant to a greater or less extent. As stated before, the course followed by a stream of water, after impact on a Pelton bucket, is such as to give a discharge almost entirely from the side of the bucket. This is shown diagrammatically in Fig. 4, and also experimentally in the accompanying Figs. 10 and 11.

In this latter photograph we have a stationary Pelton bucket receiving the correct size stream and discharging it from the sides. The course taken by the discharge will be slightly different as the wheel rotates, but the discharge will always be parallel with the entering jet, as illustrated in Fig. 12. If these statements are correct, we would find in properly designed and installed Pelton plants, where all the adjustments and sizes of streams used were correct, that the buckets would wear evenly, at least for a considerable time, until the slight pits, which almost invariably occur, would start local action, resulting in considerable wear spreading around these pits.

It is a fact worthy of notice, although I think not mentioned in the discussion on "erosion" at last year's proceedings, that erosion met with in hydraulic practice is usually of two kinds. First, we have that due to the impact of cutting particles, which acts exactly as a sand blast—the sharp corners of the quartz sand particles cutting away the material of the bucket surface. Secondly, we have a chemical erosion or corrosion, occasioned, I believe, by the escape of imprisoned air or air or other gas in solution, which, released suddenly under high pressure, may carry with it a certain amount of nascent oxygen, which on the clean metal surface would promote rapid oxidation. It usually starts at any imperceptible inequality in the castings, such as infinitesimal blow holes. The water moving

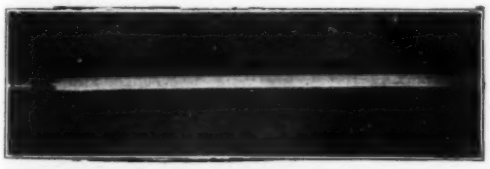


FIG. 14.—A WATER JET FROM A STANDARD PELTON TIP.

over the surface and jumping across the blow hole crater releases the oxygen of the air, possibly more readily than the nitrogen. This gives us a small pocket, or blow hole, having clean surfaces from the water friction, filled largely with oxygen gas. The oxygen combines with the clean metal, forming an oxide coating, which is cleaned off by the water friction, which will invariably occur at the slightest change in position of the bucket. The result is that the oxidizing process is repeated—the hole rapidly growing larger.

We would expect, if the above theory of chemical erosion is correct, to find the oxidized pits, as they become larger, increasing more rapidly in the direction of the bucket wedge, or creeping toward the direction from which the stream approaches, rather than from it, as the oxygen would naturally be released on the side of the pit from which the stream approaches. Such seems to be actually the fact where we can obtain an example of chemical erosion independent of mechanical erosion.

A bucket taken from one of the wheels at the Santa Ana Station of the Edison Electric Company after about twenty-seven months operation, during which it was driving a 750-kilowatt generator from a single stream under about 700 feet head, shows the oxidized pits above mentioned, which are of the color of gun metal—the oxidized depressed surfaces being clearly outlined from the smooth steel surface over which the water flows. If the erosion of these pits were due to eddy currents, the oxidized surface would be removed by such erosion. Moreover, if mechanical erosion accounted for the pitted surface of most of our water wheels, we would find the dividing knife, or splitter, the most heavily worn part. This, however, is not the case in most instances, the pitting usually occurring in the bottom and sides of the cavities. It will be readily seen that, after these pits grow large enough to alter the course of the water, they will completely change the path of the jet in the bucket cavities, and we will then have all sorts and kinds of erratic shapes, which shapes are in no way governed by the original curves of the buckets. We thus find on the same wheel buckets worn through in entirely different spots, bearing absolutely no similarity to each other, although they all started out under exactly equal conditions.

In water jets carrying imprisoned air, or air or gas in solution, due to the high pressure, we would expect to find, on relieving this pressure, a gas discharge from the outside of the stream. Fig. 14 shows you a stream under fifty-foot head, carrying air in solution. The stream at the instant of leaving the tip is perfectly clear; an instant later, or about two diameters from the point of issue, we find a slight enlargement of the stream, which the writer believes to be due to the imprisoned gas freeing itself on the relief of pressure. This disengaging process continues in this instance for about fifteen stream diameters, after which the stream begins to again clear up, although at no point is its rigidity or shape interfered with.

Fig. 15 shows another example, and under such radically different conditions as to lead me to the belief that this condition exists throughout the entire field

FIG. 15.—A STREAM OF WATER FROM A PELTON NEEDLE NOZZLE UNDER A 1,923-FOOT HEAD, AT THE STATION OF THE EDISON ELECTRIC COMPANY, LOS ANGELES, DEVELOPING 86.2 PER CENT EFFICIENCY.

of hydraulic practice. You see here a jet from a Pelton needle nozzle under a pressure in excess of a 1,900-foot head at the plant of the Edison Electric Company in southern California. The jet is of a size suitable for developing an overload on a 750-kilowatt generator, and the fog, or "water dust," immediately surrounding the jet shows clearly the disengagement of imprisoned gas. This is best observable at from one to ten diameters from the tip, and is undoubtedly a condition that exists on the bucket surface, as well as immediately surrounding the jet at point of issuance.

(To be continued.)

STATISTICS OF THE KRUPP WORKS.

FROM a report of the chamber of commerce for the district of Essen, Germany, the following facts as to the Krupp industry are derived:

The works of the firm Friedrich Krupp now comprise chiefly the cast-steel factory in Essen with a proving ground in Meppen; the Krupp steel works, formerly F. Althower & Co., at Annen, in Westphalia; the Gruson works in Buckau, near Magdeburg; the Germania dock in Kiel; blast-furnace establishments near Duisburg, Neuwied, Engers, and Rheinhaufen, and a plant near Sayn with machine factory and iron foundry; three coal mines, viz., the Hannover, Hannibal, and Saelzer & Neuack; a great number of ore mines in Germany, ten of which have deep mining plants and complete mechanical equipment. In addition, the firm Friedrich Krupp is interested in iron ore properties near Bilbao, in northern Spain, and has a shipping house at Rotterdam, with ocean steamships.

The principal sorts of outputs of the cast-steel factory in Essen are artillery (up to January 1, 1902, 39 878 pieces delivered), projectiles, percussion caps, etc., gun barrels, armor in the form of sheets and plates for all protected parts of warships, as well as for purposes of fortification, railroad material, shipbuilding material, machinery parts of all kinds, steel and iron sheets, rolls, tool and other steel, steel billets, etc.

At the cast-steel factory there were in the year 1901 about sixty plants at work; about 5,300 machine tools (including some other machines); 22 roll trains; 141 steam hammers, from 100 to 50,000 kilogrammes falling weight, with a total falling weight of 242,775 kilogrammes; 63 hydraulic presses, including two bending presses of 7,000 metric tons, one forging press of 5,000 tons and one of 2,000 tons pressure; 323 stationary steam boilers; 513 engines of 2 to 3,500 horse power (total, 43,848 horse power), 369 electromotors, 591 cranes of 400 to 150,000 kilogrammes, with a total of 6,327,900 kilogrammes lifting power.

During 1902 the furnaces all told daily smelted on the average 1,782 tons of ore from their own mines. The output of the firm's coal mines was 1,643,576 tons, and the consumption of the works (apparently limited to Essen), comprising coke and briquettes, was 1 367,-005 tons.

The Essen steel works possess about 65 kilometers of broad-gage railroad track, with 16 tank locomotives and 714 cars, and a narrow-gage system, with about 48 kilometers of track; 27 locomotives and 1,209 cars. The telegraph system of these works comprises 31 stations, 58 Morse instruments and 81 kilometers of conductor. The communication between it and the imperial telegraph office in Essen amounted in 1902 to 22,585 messages. The telephone system comprises 399 stations with 407 instruments and 375 kilometers of wire. On the average it is used 2,400 to 2,500 times a day.

The fire protective service of the Essen establishment includes a principal guard and two auxiliary guards, comprising 100 persons, with numerous hydrants, alarm stations, etc., for the works and their dependent colonies.

On the Meppen proving ground 12,200 shots were fired in 1902. On a shooting range at the steel works itself, about 13,000 shots were fired. On the two combined about 56,000 pounds of powder were consumed.

The total contributions of the firm in 1901 to funds for illness and accident insurance, pensions, support, etc., of their employes, etc., whether required by law or otherwise, amounted to 3,063 704.6 marks.

According to a census of April 1, 1903, the total number of persons employed at the Krupp works, including 4,046 officials, was 41,013. Of these 22,970 were employed at the Essen steel works, 2,651 at the Gruson works in Buckau, 3 062 at the Germania dock in Kiel, 6,620 at the coal mines and 5,710 at the blast furnaces, Meppen proving ground, etc. The number of dependents of the Krupp works, including women and children, was, according to a count made in May, 1900, 147,645.

ORIGIN AND DEVELOPMENT OF ARMORED CONCRETE.

IT would be a very difficult task indeed to discover the inventor of armored concrete, either in principle or application. It is, however, well known that it was in Austria and Germany that this method of compound construction first came into prominent notice in Europe. Recently a very interesting case, which throws some light on the subject, has, according to our contemporary, Annales des Travaux Publics en Belgique, been brought before the patent courts in France. It appears that the general design and the forms of many of the most modern applications of ferro-concrete building introduced into France, constitute the subjects of patents taken out by M. Monier, who is looked upon as the inventor of that system. The builders and those engaged in cognate transactions and negotiations, who in France are in favor of this method, and push it forward with the greatest energy, have, it is stated, exhibited nothing whatever that is new in their own patents, which are therefore legally of no value. This view of the case appealed particularly to M. Hennebique, who, to some extent, personifies armored concrete in its latest development. It is estimated that the total value of armored concrete buildings erected on the Hennebique system amounts to the large sum of £4,800,000. It is evident, considering the important interests at stake, that there could be but one way of settling the matter, and that was by appealing to the laws of the country, with the result we are about to describe.

Some time previously M. Boussiron and M. Piketty, Parisian builders, had constructed some buildings of armored concrete resembling in certain respects those erected on the Hennebique system. Under these circumstances, M. Hennebique, considering himself aggrieved by what he regarded as an infringement of his own patents, brought an action against them for damages. On the other side, MM. Boussiron and Piketty contended that the patents of M. Hennebique should be annulled, and the case went for decision before the tribunal of the Seine. The patent obtained by M. Hennebique in 1892, and the additional certificate granted in the following year, claimed as the very essence of the invention the use of straps or stirrups, which, while uniting the armor bars under a tensile stress in the lower part of the girder, with the concrete in the upper part acting in compression, were intended to resist the shearing stresses. So far so good, and, had no rebutting evidence been forthcoming, the patent of Hennebique would no doubt have been valid. But, in 1878, Monier, who had, the year previously, taken out a patent for various applications of armored concrete, specified, in a subsequent addition to it, the particular form in which he employed his system of construction as applied to beams and girders. It was clearly shown in the drawings attached to the patent that Monier built up his armature of upper and lower iron bars, which were united by rods in the shape of a U, of which the ends were bent over to get a good grip of the cement. The similarity between the two patents is very apparent. It mattered nothing that Monier might have intended to add other constituent parts to his original armature, as they would not have affected the result to be achieved by the patent. Again, with regard to a rival patent, the omission to specify some of the constituent parts of the Monier beams would not, *per se*, constitute an invention, especially if it is not claimed that the omission would produce any novel and better result. It is to no purpose that M. Hennebique contends that the characteristic feature of his patent consists in the possibility of erecting

and fixing in place armored concrete beams and girders owing to the mobility of the iron stirrups. No mention of such a contingency is made in his patents, and besides, this property is common also to the Monier system. So far as concerns the patent procured by M. Boussiron in 1899, it presents so strong an analogy to that of M. Hennebique, as virtually to amount to an infringement. It is, in fact, doubly invalid, being so rendered by Monier's patent, taken out in 1877, and also by that of M. Hennebique, procured in 1892, which was found to be overridden by the former. The definite settlement of these rival claims is unquestionably a matter of considerable importance alike to engineers, builders, and manufacturers in France and elsewhere. After hearing the whole case, the tribunal of the Seine decreed that the patent obtained by M. Hennebique in 1892 was null and void, inasmuch as he claims for armored concrete girders, in which iron bars are inserted in the lower part, and bands or clasps are used to maintain these bars apart. It also declared that the patent taken out by M. Boussiron in 1899 was equally invalid, since it related to the same object. The tribunal rejected the claim for damages, and ordered M. Hennebique to pay the costs of the action.—Engineer.

[Concluded from SUPPLEMENT No. 1454, page 23306.]

THE RELATIONS BETWEEN SCIENTIFIC RESEARCH AND CHEMICAL INDUSTRY.*

I HAVE left but little time for dealing with an industry with which I have had long personal connection—the manufacture of coloring matters and other products from coal tar. The relations between scientific research and this industry are so intimate, and are so frequently referred to in public, that it has become a kind of stock example for the use of those who wish to emphasize the interdependence of science and industry. The history of this industry, moreover, is particularly instructive from our present point of view, because it originated in this country in 1858 and flourished here for a period of about twenty years, and then began to decline. The chief center of activity for the production of coal tar products at the present time is Germany, where there are six large factories and a number of smaller ones. The aggregate capital of the six large factories amounts to some £3,000,000, and they give employment to about 20,000 people, including chemists, engineers, clerks and travelers, dyers and draftsmen, workmen, etc. These large firms pay dividends varying between 5 and 25 per cent up on their capital. The total value of the tar products manufactured in Germany exceeds £10,000,000 annually, and she supplies by far the largest proportion of the dyestuffs used throughout the world. When, in 1886, I proclaimed our approaching fate with respect to this industry, I found that we were then using about 90 per cent of German and other foreign coloring matters in this country, and my friend, Prof. Arthur Green, of the Yorkshire College, finds that things are in about the same state at the present time.

The coal tar color industry arose, in the first place, from an observation made by Dr. W. H. Perkin in 1856 in the course of a research having for its object the synthesis of quinine. He did not succeed in producing the alkaloid, but he noticed that aniline, when oxidized, gave a coloring matter, which he manufactured and introduced under the name of "mauve," and so laid the foundations of an industry which has developed to its present colossal dimensions. The art of the dyer and calico-printer has been absolutely revolutionized by the introduction of the synthetical coloring matters prepared from coal tar. Of these more than 500 are now available—each one a distinct and definite chemical compound with characteristic color; each one with properties rendering it suitable for application to particular classes of fabrics. Every range of color, including the deepest black, can be imparted, and every degree of brilliancy or dullness, of fastness to light, to washing, and bleaching agents, etc., can be realized as required. The natural dye-stuffs, such as madder, which supplied alizarin for Turkey red; the cochineal insect, which furnished a red dye; the lichens and dyewoods, which were used by the old-time dyers, have been displaced, or are on the way to displacement, by the tar products. The most important of all the natural coloring matters, indigo, is, as you know, among the latest of the achievements of industrial synthetical chemistry, and a great industry worth some £3,000,000 annually to our Indian Empire is threatened with extermination by the German manufacturers. Not a month passes without the introduction of new coloring matters, and so enterprising are the German color makers that their pattern-books are issued with full directions in various languages, and trained chemists in their service will give personal instructions to our dyers in the application of new and unfamiliar coloring matters.

It is impossible to do more than allude in passing to the enormous influence of this greatest and most refined of all the chemical industries upon every other department of chemical manufacture. It has reacted and is reacting with ever multiplying ramifications upon the manufacture of the raw materials, such as acids and alkalies, it is revolutionizing the methods for producing sulphuric acid, it is pressing into its service electrolytic processes, and it has created new branches of engineering for the construction of special plant and machinery. The utilization of the infinity of compounds present in the tar is no longer restricted to the production of coloring matters. Valuable medicinal preparations, photographic materials, perfumes, antiseptics, the sweet-tasting saccharin, which is 300 times sweeter than sugar, an artificial musk which exceeds in intensity of odor any natural musk, are among the manufactured products from coal tar. The industry is the direct outcome of scientific research; it has been developed by research, and is being still developed by research. Both methods referred to in this address have been, and are, at work. The by-results of pure scientific investigation are seized upon whenever they show the slightest chance of being industrially useful. Saccharin is such a by-result. The chemical reactions which culminated in the industrial production of indigo were published by their discoverer, the late Dr. Heumann, as an academic discovery in the first place, and were developed industrially by the "Badische Anilin und Soda Fabrik" of Ludwigshafen. By the other method whole armies of highly trained scientific chemists are constantly at work in the splendidly equipped research laboratories of the German factories investigating new products and processes with the direct object of their ultimate industrial application. Nor must it be forgotten that under the term "research" used in this connection is comprised also theoretical research. A close study of the history of this industry will show how throughout it has been vitalized by theoretical conceptions concerning the chemical structure of the molecules of organic compounds, and especially by the so-called benzene ring theory of Kekulé, now so familiar to chemical students. The force of illustration of the connection between science and industry can, perhaps, go no further than in this case, where a purely abstract conception based on a knowledge of the properties of the atom of carbon has reacted upon a branch of manufacture to its lasting benefit.

I have thought it best to limit my treatment to the record of bare facts in order to bring home to you in a concrete way how chemical industry and chemical research are interdependent. Four groups of industries have been dealt with; it would have been easy to subdivide the subject and to deal with four dozen. I must confess that I am getting rather tired of what may be called the platform treatment of education in applied science, which consists in general of the purely clerical or office-boy work of compiling information—doubtless very valuable in its way—concerning the number of schools in foreign countries, the acreage of land which they cover, their cubic contents, cost of erection and maintenance, the number of professors and staff, and the number of students which they turn out annually. The reason why this kind of information is getting stale and wearisome is because it produced at first no effect at all in this country, and then it led to a reckless expenditure in bricks and mortar, and the starting of institutions which are inadequately endowed, insufficiently maintained, and altogether lower in their working capabilities than the continental institutions which prompted their foundation. I thought, therefore, that it might be more acceptable if, instead of dealing with the usual generalities of the statistical order, I sketched the history of a few specific industries. If it appears that Germany has played a very prominent part in these histories, all I can say is that there has been no intentional selection on my part, but it is entirely due to the circumstance that it is to that country more than to any other that industry owes its advancement by scientific method. The pre-eminence of Germany in chemical industry is sufficiently notorious, as our own manufacturers know to their cost. The most striking feature of the exhibition at Paris in 1900, when, as a member of the International Jury for Chemical Products, I had occasion to examine the exhibits of all countries, was the collective exhibit of chemical products displayed by some ninety German firms. This splendid collection, which revealed more than anything the enormous advances made in chemical industry by Germany, is now deposited in a special building in the grounds of the Technical High School at Charlottenburg.

So much has been said and written about the causes of this wonderful development of German chemical manufactures that I hesitate to add anything more to the discussion. Certainly it is not possible to add anything new. Those who, like Prof. Michael Sadler and Dr. Rose, have made a special study of German educational systems have placed before the public valuable reports in which these causes are fully discussed from the educational point of view.* In the official report to the French government on the products of Class 87, Prof. Haller, the secretary to our jury and author of the report, has devoted a whole section to the "Causes de la Prospérité de l'Industrie Chimique Allemande." The general conclusion to which we have all come concerning this remarkable industrial development is that it is mainly due to the higher educational level in Germany with respect more especially to the highest scientific instruction in the universities and technical high schools. It is perhaps permissible to go one stage further back, and to say that this advanced scientific education is in itself the expression of the public faith in such education, and the recognition by the State of the industrial value of such training. It has been well pointed out that the money invested by the German nation in founding and maintaining the chemical chairs at the universities and technical high schools is now worth some £50,000,000 annually to the country in this branch of industry alone. More especially, also, it may be claimed that the recognition of the value—the indispensable value—of scientific research to industry by the manufacturers themselves has been one of the most potent factors in developing German chemical industry, and the lack of such appreciation on the part of our own manufacturers has been one of the chief causes of their decadence.

In so far as the subject under consideration is an educational one, it comes within the province of a gathering of students held under the auspices of the most ancient seats of learning in this country. At any rate, the topic is one of such supreme importance to the welfare of this nation that I could not resist the invitation to take part in your proceedings, because the question is one which has been for years undergoing the most serious consideration by those who have, like myself, been connected on the one hand with manufacturing industry and on the other hand with the teaching of science. Whether the old universities are desirous of making a new departure and of enlarging their spheres of activity so as to bring them more into harmony with the practical requirements of the age I have no authority to discuss. Certainly, Cambridge, by the establishment of departments of engineering and agriculture, has made a distinct advance in this direction. At any rate, it may be taken as a sign of the times that the relationship between science and industry has been made a special feature of this year's university extension meeting, and the outer world will, no doubt, take due cognizance of the circumstance that a subject has been chosen for consideration which, in this country, is generally considered quite remote from the higher ideals of university education.

It is evident from what has long been going on in Germany and America, and from what is now taking place with regard to education by our newer universities here, that applied science is, or can be, brought within the province of university education. Of course, if the view be held that science is degraded by being turned to practical account, then we must not look to the universities for the training of our industrial leaders. It is impossible, however, to note the progress of events since the coalescence of science and industry abroad without coming to the conclusion that the position of a nation in the scale of civilization will be measured in the future by its productive energy—by the capacity of its workers to evolve new ideas and to carry them out practically; by the number, zeal, and originality of its scientific workers, and by their mastery over the resources of nature. I do not mean to imply that the old universities have done nothing toward the education of scientific thinkers and workers. What strikes outsiders like myself is the very small part that these universities are taking in the modern equipment of the great industrial army of Britain as compared with the work being done by foreign universities for their respective countries. In view of the industrial struggle between nations which has arisen through the discoveries of modern science—a struggle which is bound to become keener with the progress of science—it cannot be seriously maintained that the material welfare of our country is beneath the dignity of even the most profound academic scholar. The old definition of a university as an educational center for the cultivation of useless knowledge no longer holds good. If there are universities which still cling to this tradition concerning their functions, it may safely be predicted that their influence in moulding the future life of the nation is destined to shrink to smaller and smaller dimensions.

The part played by the German universities and technical high schools in the training of technologists is now so well known in this country that a detailed restatement of the facts is hardly necessary. I may remind you that their twenty universities, with foundations dating from the fourteenth to the beginning of the nineteenth century, for many years supplied the factories with men thoroughly trained in science, and capable of applying their knowledge to industrial processes. With the development of manufacturing industry along scientific lines it was found necessary to provide more specialized education, and during the first half of the nineteenth century trade schools or polytechnics were called into existence in nine different centers. Of course, you know that our polytechnics here have very little analogy with the German institutions of that name. The polytechnics were in time found inadequate to meet the growing requirements of German industrial training, and their functions were accordingly enlarged and their educational status raised. Out of these nine polytechnics or trade schools have arisen nine technical high schools, and two more such schools are now in course of erection. Thus in Germany both universities and technical high schools are catering for the scientific needs of the national industries. I may add that a few years ago there was a serious discussion in Germany among certain educational bodies and industrial organizations as to whether the State should not be asked further to strengthen the scientific faculties of the universities by creating chairs of technical or applied chemistry, and although there has been no practical outcome of this movement as yet, it is an instructive illustration of the spirit which is abroad in that country.

There is very much misapprehension here concerning the nature and functions of the German technical high schools. They are not glorified polytechnics of our own type for teaching handicrafts to artisans or smatterings of science to ill-prepared students. They are institutions of university rank—their education is of university standard, and their professors stand on a level with the professors of the universities. Their students are not admitted until they have reached a high standard of general secondary education. Their courses of instruction are as purely scientific as the university courses, and the only difference between the two kinds of education is that the technical high school is all scientific, and the various sciences are taught both theoretically and practically with a view to their ultimate industrial applications. It is a "technical education" in the highest and best sense, and not in the narrow—I may even say degraded—sense in which the term is so frequently used in this country.

The question of the hour which the old universities have now to face is whether they are willing to take part in the newer education required by our industrial leaders, whether they are prepared to strengthen and develop the teaching of those physical sciences which underlie productive industry, and to recognize the claims of the applied sciences as subjects worthy of inclusion in their curricula. There will, of course, be a divergence of opinion with regard to this question. There will be the old, old conflict between the advocates of the "humanizing" influence of the ancient classical studies and the supporters of modern scientific education. So far as my opinions are worth anything, I cannot see, and I never could see, why a study of nature at first hand should be less "humanizing" than the study of those classical subjects which have so long held the field. I admit that the teaching of the physical sciences as they should be taught at the present time in any institution of university rank is more costly—that the equipment consists of something more than a library, and that their teachers, to be effective, should be themselves active investigators, inspiring originality and a desire for creating new knowledge in their students. I can understand that a subject which to the classical don wears the aspect of a financial ogre should be kept down as long as he has a preponderating influence in regulating the affairs of his

* A lecture delivered at the University Extension Meeting at Oxford on August 3, by Prof. Raphael Meldola, F.R.S.

* See especially vol. ix. of the special reports issued by the Board of Education, entitled "Education in Germany," by Prof. Sadler. Also Dr. Rose's diplomatic and Consular reports, issued by the Foreign Office, No. 561, "Chemical Instruction and Chemical Industries in Germany"; No. 591, "German Technical High Schools"; No. 594, "Agricultural Instruction in Germany and the Development of German Agriculture and Agricultural Industries."

university. But this is a matter of expediency, and not a real conflict between fundamental principles. I cannot find that the classical teaching of the American or German universities has been impaired by the splendid development of their scientific faculties; neither does it appear that the human products of their scientific activities are in the least degree inferior as men to their classical scholars. Of course, I am a special pleader, and I am making the best use of my opportunities, and I repeat that I never could see where any antagonism existed between the older and the newer studies, excepting in the struggle for financial means. There are many educational authorities here and abroad who will tell you that the scientific development of the German universities has reacted upon and improved the classical teaching by an infusion of scientific method into the latter. Moreover, it must be remembered that we who are advocates for the new education are not clamoring, as many people think, for the abolition of the old studies. I for one should deplore any falling off in the prestige of the old universities as seats of classical learning. Neither is it suggested that our future leaders of industry would never at any period of their studies derive benefit from that particular kind of culture which the ancient literature is capable of imparting. I firmly believe they would; but the question as to when and how would open up the whole field of education, elementary, secondary, and university, both pre- and post-graduate, and I should find myself floundering among shoals and quicksands in no time. The ideal university is one that offers facilities for both the older and the newer education; they are not mutually exclusive—they can, and do, thrive side by side elsewhere, and there is no reason, at any rate no theoretical reason, why they should not do so here.

The form in which the question may be put is therefore whether, given the means, the older universities should develop their work in the direction of applied science. A large body—I cannot say how many—of outsiders who are well-wishers of these universities, is of opinion that they should, and there is an idea abroad that they are, suffering financially now from having neglected this side of education in the past. There was, for example, a leading article in the Times of May 25 in the course of which the writer suggests that they may have suffered through having a false reputation for being very wealthy bodies, and he adds: "Or is it, perchance, because the modern millionaire, being a man of his age, and an Englishman to boot, has no great belief in the economic value of knowledge as such, and no great confidence in the capacity of our ancient universities to adapt themselves to the needs of the coming time?" Now, so far as the chemical manufacturers of this country are concerned, I can say with some personal experiences of my own that they certainly have shown no great belief hitherto in the economic value of scientific knowledge, as they now know to their own cost. But if, to make a purely hypothetical conjecture, some beneficent millionaire were to test the capacity of our old universities for undertaking this kind of work, and were to offer adequate means for the purpose, I feel pretty confident, from what I know of the spirit which dominates their governing bodies, that such an offer would be accepted both at Cambridge and here at Oxford, with few dissentients. If such a departure were placed within their power, I think that that great public which glories in the past achievements of these universities would rejoice in their new development. And I will further add that the creation of chairs of applied science would react upon and strengthen the teaching of all those sciences which are in any way connected with industrial productiveness.

Of course, this is all hypothesis—the most nebulous of hypotheses. We all know, unfortunately, that the financial resources of the universities have been, and are, inadequate for the purpose of enabling them to meet the requirements of modern scientific education, either in the way of staff, accommodation, or equipment. It can be said, and justly said, that so long as these universities are without the means of developing their schools of pure physical science to an extent worthy of their reputation, it is useless to talk about developing the teaching of applied science. So it may be. But I remind you that we are still in the region of hypothesis, and the captious critic might retort by saying they they have not done even as much as they might, and could, have done for the proper development of scientific teaching with the means already at their disposal—that they are still overweighted by ancient tradition, and that their internal scientific forces are still feeble as compared with the preponderating forces of the advocates of the older culture. There is no time, even if I knew enough about the inner mechanism of university administration, to discuss this aspect of the question, but if you want to know an American view of the case—a strong view!—I would invite attention to an address by Prof. Victor Alderson, Dean of the Armour Institute of Technology, delivered before the Chicago Literary Club in October last year, an abstract of which was published in Nature of February 12.

The question of the recognition of applied science by our old universities must, as I said, be faced—the time is at hand for them to consider seriously whether it is desirable that they should cater for the training of those who are destined to be the founders and upholders of our national prosperity. The longer this question is shelved the smaller will grow the chances of their being able to participate in the work. At present we in this country are not up to the German level so far as concerns the higher technical training of industrial leaders. Our universities, in other words, have not yet had to encounter the full force of competition with newer institutions of the rank of the technical high schools. We have but very few, if any, schools of this status here now, but if I read the signs of the times correctly, the differentiation between the old and the new education—which has already become well marked— is bound with the progress of science to become more and more strongly pronounced. Our newer universities—especially those in large manufacturing centers—will be driven more and more into the teaching of applied science, and our polytechnics and technical colleges will perforce have to raise their educational standard. The effect cannot but be to cause the older universities to become of smaller importance in the general scheme of national education as time goes on. That is why I have taken advantage of the opportunity which has been placed in my hands for raising this note of alarm, because even if nothing practical results from this meeting, it may at any rate be useful to let it be known that many of us desire to see the most ancient and the most renowned of our educational foundations doing more for the education of a nation the prosperity of which is so largely dependent on productive industry.

Whether as the outcome of the lectures delivered and the conferences held during this meeting the attitude of the universities toward applied science undergoes modification or not, the ventilation of opinions cannot but be of advantage in many ways. If, for example, it is made manifest that the current of national thought is moving slowly—alas! very slowly—toward the recognition of science as the main factor of industrial progress, it may help to emphasize the necessity for strengthening and developing the teaching of pure science. If the beneficent millionaires are not forthcoming for the purpose of endowing applied science, there is, at any rate, ample scope for their beneficence in the endowment of pure science in our old universities. A school of active science workers would—to use a quasi-scientific expression found in the pages of many writers of fiction—"galvanize into life" the science of teaching of the schools. If you can only help to mold the public mind into the belief that science is a living reality veiling truths of inestimable value to humanity from every point of view, moral, social, and material—truths that are to be wrested only by conscientious, laborious, and persistent *research*—you will be assisting a great cause. If you will proclaim this doctrine from the housetops and assist in sweeping away that dustheap of formal textbook knowledge which passes for science in our examination rooms you will be doing something toward raising the general level of opinion in this country. We need it badly! Think of all the creative intellectual power running to waste—the unrealized assets in the way of originality of thought which Great Britain might have at her disposal if the brain power of her teachers and students were only diverted into the right channels. The old universities, by virtue of their prestige, their traditions, and their past achievements, have still a powerful hold upon the public mind. They must open their doors still more widely to science if they wish to retain their hold. If their means are at present insufficient to enable them to meet the requirements of the age, they can still forward the national cause by upholding the dignity of science, by insisting upon originality of thought as an essential qualification for its successful teaching, and by helping to dispel the notion that it undergoes degradation by being applied to human welfare. It must be realized, and it cannot be realized too soon, that the peaceful campaign of industrial competition requires leaders well trained in scientific method, and not crammed with mere formal book learning—men as alert in mind and resourceful in meeting difficulties, as upright in principle, as keen in enthusiasm, as far-seeing in imagination, and with as intimate a knowledge of human nature as the statesmen, warriors, divines, lawyers, and schoolmasters which these old universities have given to the country. The victory of the future is with that nation which enables her children to approximate more closely toward Tennyson's ideal:

> " . . . the crowning race
> Of those that eye to eye shall look
> On knowledge; under whose command
> Is Earth and Earth's: and in their hand
> Is Nature like an open book."

RADIUM IN MEDICINE.*

By SAMUEL G. TRACY, B.S., M.D., New York.

THERE is no doubt that the salts of radium by their radiations have a positive effect on diseased tissues, and, even at this early stage of experimentation, it certainly looks as though their use were indicated in lupus, rodent ulcer, superficial cancer, and some cases of deep cancer; in certain kinds of skin diseases, atrophy of the optic nerve, and partial blindness from other causes. In deep seated cancers, the X-rays have, as a rule, not given satisfactory results. It would almost seem that, in the radium rays, which are more powerful and their emanations of radioactivity more penetrating, we have a new agent which is more likely to give better results in some of the cases which have heretofore been considered incurable. As yet, comparatively few physicians have reported on the efficiency of radium rays in deep-seated cancer. Nevertheless, there is sufficient encouragement in the cases which I now collect and report, to make us feel that perhaps we are on the right road to find the specific cure for cancer and tuberculosis.

Case I.—Dr. John McIntire, of Glasgow, reports a case of small lupus on the dorsal surface of the right hand, which was exposed to the radium rays daily for from twenty minutes to half an hour, the time of exposure depending upon the skin reaction. The result was that within three weeks the lesion was entirely healed.

Case II.—Female, aged twenty-eight years, with lupus of the nostril and nose about one inch in diameter. She had the same daily treatment as in the previous case, with the result that she was cured in four weeks.

Case III.—Rodent ulcer, under treatment only two weeks at the time of the report and even in this short time the discharge had dried up and the ulcer was in a fair way to heal.

Dr. Oudin, of Paris, says that he has cured some cases of lupus with radium rays, but the report does not give the details.

Prof. Gassenbaurer reports to the Vienna Medical Society no less than twenty cases of cancer treated by radium during the six months ending July 1. All these cases showed more or less improvement, and the two whose history I now give, were cured.

Case I.—Male, aged thirty-seven years; operated on eight years ago for melanosarcoma of the left arm. He recently returned to the clinic because of a multiple recurrence of the same. The numerous nodules were exposed to the radium rays for twenty-five minutes each day or two, depending upon the skin reaction, and the cancerous nodule disappeared in one month.

Case II.—Male, aged sixty-one years; operated on for cancer of the mouth in 1888, 1891, and 1897, respectively. He presented himself in the clinic again in April, 1903, with an inoperable cancer of the lip and palate. Radium was used as in the above case, and the cancerous growth disappeared with complete healing in five weeks.

Dr. Willy Meyer, and William J. Hammer, of New York, report a case of recurrent cancer in which the X-rays, and also Coley's fluid, had been used for about a year without avail. Last July, Dr. Meyer began radium treatment. The radium was of 300,000 activity, and was applied every day for one minute. The large recurrent growth in the axillary line got smaller and less painful, and the smaller disseminated nodules broke more quickly. However, the case was so far advanced that, while improvement took place, a cure could not be accomplished.

Dr. Andrew H. Smith, of New York, while abroad this summer, saw a case of rodent ulcer which had been treated by the X-rays without benefit. The ulcer was exposed to radium rays for five treatments, which resulted in perfect healing of the parts.

Bacteriological Experiments with Radium.—The observations made with radium in bacteriology have been somewhat limited. However, Caspari and Ashkassi, of Italy, have exposed culture tubes of the *Micrococcus prodigiosus* to the rays of radium, and it has been found to have a fatal effect on this organism in three hours.

Radium Rays in Tuberculosis of the Lungs.—From the well known germicidal powers of radium, it is reasonable to suppose that it will prove a useful agent in tuberculosis of the lungs. Soddy, in the British Medical Journal, suggests that radium be dissolved in water. He says that "instantly all its emanations are evolved in gas, and mixed with the air above the solution. Now let these emanations be removed by a current of air passing through the solution. The air with the emanations can now be stored in a gas holder in another room. Observations will show that one half of the emanations will disappear every four days, and in three weeks no emanations of radium will be left; but the solution from which it was obtained, has grown a fresh crop of emanations just as fast as the old ones disappear. That is, it takes about three weeks for the solution of radium to be as potent as it was in the beginning when the salts of radium were first dropped into it."

Inhalations of these emanations leave a thin film of radioactive substance on the lungs. This causes the phenomenon of induced radioactivity, which remains in the air cells of lungs, exercising a germicidal power over diseased tissue long after the emanations themselves have been exhaled. This "induced radioactivity" usually disappears in about three hours. For an inhaler, an ordinary gas wash bottle provided with two taps could be used, so that there is no leakage of these precious and slowly formed emanations. From five to ten milligrammes of dry radium bromide should be introduced into the wash bottle and a few drops of water drawn in to dissolve it the taps being immediately closed. For the first treatment, the first few bubbles of gas should be inhaled with a deep breath, gradually increasing the dose. Repeat this treatment every day. In this manner the emanations of radium and their radioactivity, which is inimical to germ life, would do their work at the seat of the disease.

Perhaps the foregoing reports are somewhat rosy colored in their expectations; on the other hand they may be in some respects not sufficiently extravagant—time will tell. However, to the inexperienced it is well not to draw unwarrantable conclusions concerning this wonderful substance, and to imagine that in radium we have a specific for all incurable diseases. No doubt, in time, scientific experimentation will show its value as a remedy, and perhaps reveal its mysteries, and the natural laws through which it works.

CONCLUSIONS.

1. The discovery of radium may make it necessary to change our theories of the old hypothesis about matter and the conservation of energy.
2. Radium may possibly open up the way for a cheaper and more wholesome lighting of houses by phosphorescence.
3. Radium is a practical agent to differentiate genuine gems from artificial.
4. Radium is a useful agent to kill bacteria.
5. Radium may be considered a valuable agent for the treatment of lupus, cancer, tuberculosis; and a possible agent to improve the eyesight and overcome partial blindness. No doubt, later discoveries will show it to be of service in other diseased conditions.

* Read at the semi-annual meeting of the Medical Society of the State of New York, held at the New York Academy of Medicine, October 1, 1903.

NEW MORDANTING PROCESS.

IT is well known that the ordinary method of mordanting wool with a bichromate and a reducing agent always makes the fiber more or less tender, and Amend proposed to substitute the use of a solution of chromic acid containing 1 to 2 per cent of the weight of the wool, at a temperature not exceeding 65 deg. C., and to treat it afterward with a solution of sodium bisulphite. According to a recent French patent, better results are obtained with neutral or slightly basic chromium sulphocyanide. This salt, if neutral or only very slightly basic, will mordant wool at 65 deg. C. The double sulphocyanide of chromium and ammonium, got by dissolving chromic oxide in ammonium sulphocyanide can also be used. Nevertheless, in order to precipitate chromium chromate on the fiber, it is advisable to have a soluble chromate and a nitrate present, as well as a soluble copper salt and a free acid. One example of the process is as follows: Make the bath with 2 to 3 per cent of ammonio-chromium

sulphocyanide, one-half of 1 per cent sodium bichromate, one-third of 1 per cent sodium nitrite, one-third of 1 per cent sulphate of copper, and 1.5 per cent sulphuric acid—percentages based on the weight of the wool. Enter cold and slowly heat to about 60 deg. to 65 deg. C. Then work for half an hour, lift and rinse. The bath does not exhaust and can be reinforced and used again.

THE COLOSSAL CAVERN OF KENTUCKY.

By DR. HORACE C. HOVEY.

THE cavern region of the Ohio Valley covers about 8,000 square miles. Originally an immense plain, it was slowly uplifted from the sea, and carved into its present picturesque appearance by the process of erosion. There are thousands of pyramidal peaks, known as "knobs," often rising to the height of several hundred feet; and also many thousands of oval depressions, or "sink-holes," without inlet or outlet, except as drained into subterranean channels, to emerge into cave-fed rivers, the most notable of which is the Green River.

Besides the famous Mammoth Cave, and in its vicinity, are a number of other caves and grottoes, each having its attractions. Among them are the Dixon, White, Bone, Wind, Long, Short, Diamond, Wilson, Proctor, Ganter, Grand Crystal, Salt, and Bed-quilt caves. The Salt Cave has vast chambers and avenues, and is rich in Indian remains. Its entrance is blocked by huge stones and it contains no water; hence it is seldom visited. The Bed-quilt Cave got its odd name from the fact of an Indian bed-quilt having been found in it. Until recently it has attracted little notice.

On the 16th of July, 1895, the veteran guide and explorer, Mr. William Garvin, a colored man, observed an opening in a hill-side, on property adjoining his farm. On examination this proved to be the apex of a subterranean dome, thus laid bare by the washing down of the hill-side. Bringing several ladders, he and his neighbors climbed down for 66 feet, to the floor of the dome, which was about 15 feet in diameter. Pursuing a winding path for 1,200 feet, in a northerly direction, and passing numerous pits and domes, cascades and interesting formations, they reached a point where five domes unite in a large opening called appropriately Quinque Dome. The avenue is named for its discoverer, Garvin Avenue.

The exit from Quinque Dome was by a low passage, afterward enlarged by blasting. The wild pathway led to an opening that seemed to descend to the heart of the earth. On subsequent visits the explorers brought in planks which were laid down for 50 feet, for the safety of visitors. Then a windlass was erected and a rope was rigged, by which those who dared could be lowered, spinning round and round in midair and the blackness of darkness, till they landed far, far below on the floor of what was well named the Colossal Dome. The adjective was also applied to the entire cavern, on account of its immense size, and the Colossal Cave is a worthy rival of its near neighbor, the Mammoth Cave.

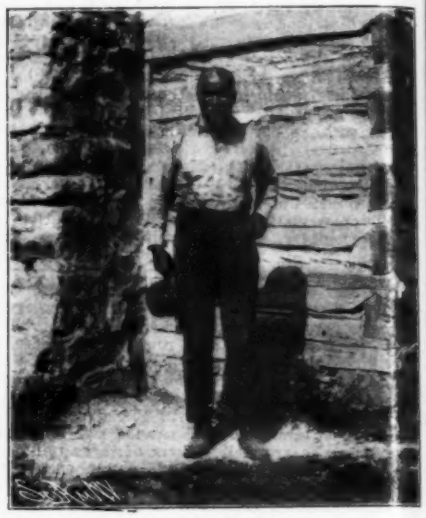
On January 26, 1896, the Louisville & Nashville Railroad Company purchased this magnificent cavern from Dr. L. W. Hazen, on whose farm the original entrance was located, and for a time employed him as their agent. As exploration was pushed in various directions the company bought the land under which its course was found to run, and large sums have been expended in widening narrow passage-ways, smoothing rough places, building stairways where desirable for comfort, and doing other things to make exploration easy. The present writer prepared a short account of this cave, from the observations made by Mr. Ben Hains and Mr. John M. Nelson; but did not personally visit it till last summer.

Formerly the way to reach the Colossal Cave was by a wagon road from Proctor's Station to the foot of Hazen's Hill. But now the better way is by a road leading from the Mammoth Cave hotel for one mile and a half, to a new entrance artificially opened by Mr. Tom Lee, on Mr. Garvin's farm of thirty acres, which was bought from him for the purpose. At a point about 500 feet east of this other entrances were discovered, which were afterward closed to prevent intrusion by undesirable parties for the purpose of spoliation. There is almost always more or less litigation connected with the legitimate occupancy of any great cavern; and while some of this was going on, the company employed parties to make a thorough and accurate survey of their underground possessions.

Previous to this no one had ever entered the Colossal Cave from the Bed-quilt Cave; but now the surveyors went in by that passage, being prevented from going in by the usual entrance. Otherwise this branch of the labyrinth does not seem of especial interest.

EXTERIOR ENTRANCE TO COLOSSAL CAVERN.

IN HELICTITE CHAMBER—COLOSSAL CAVERN.



Copyright 1903, H. C. Hovey.

WILLIAM GARVIN, THE GUIDE.

ENTRANCE TO COLOSSAL CAVERN (FROM INSIDE.)

THE LIZARD SPRING.

THE COLOSSAL CAVERN OF KENTUCKY.

Edgar Vaughan, C.E., and W. L. Marshall, C.E., connected with the real estate department of the company, assisted by J. M. Armstrong, C.E., made a survey of a large part of the Colossal Cave, by tape and transit, noting minutely all dimensions and directions.

The valuable results thus obtained were kindly placed at the disposal of the writer, by whom their work is reproduced in the form of the accompanying map, giving only those details that have some degree of interest for the general public. The reader will observe that much ground yet remains to be surveyed, and also that it is necessary to exaggerate the width of the passage-way as compared with its length, in the reproduction. No attempt is made to give vertical measurements on the map, though indicated in the survey. The names of many minor localities are omitted, while a number of important ones are indicated by figures referring to a key. The portion surveyed and mapped has a total linear length of about 14,000 feet; not including the long tortuous, and difficult way, beginning at the Wild Goose Chase, and leading down to the river region, which by many is conjectured to connect with the rivers of the Mammoth Cave; nor including several side avenues as yet imperfectly explored.

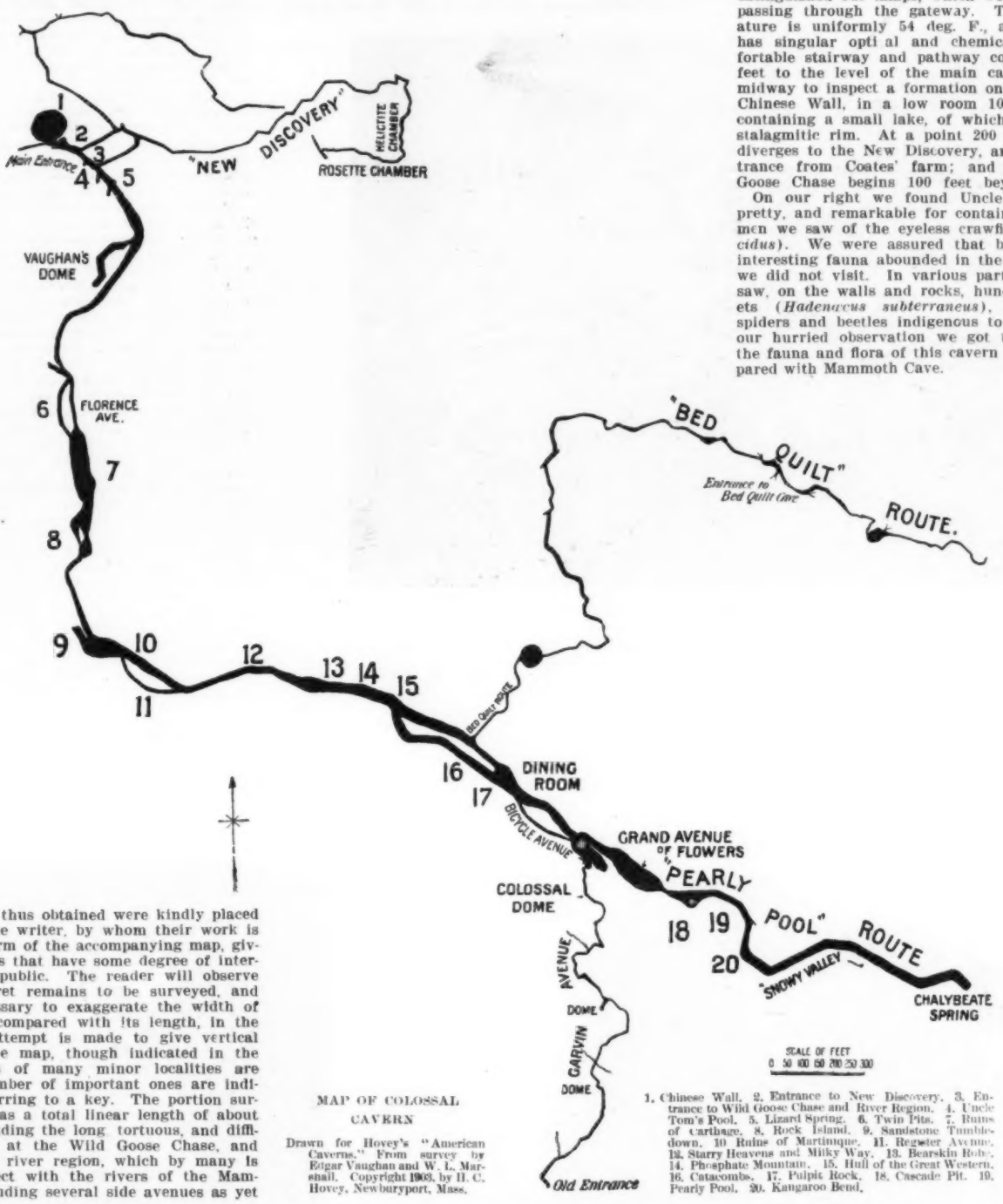
Accompanied by Mr. Gerard Fowke, an archæologist of note, the writer availed himself of the courtesy of the company, last July, and made as thorough an examination of the wonders of Colossal Cave as was possible in the few days at his disposal. Both of us had the benefit of long experience in work of this nature; and our able and intelligent guides were the Messrs. J. M. Hunt and Morris Hunt.

We began by paying a visit to William Garvin, the discoverer of the cave, whose photograph we took, only regretting that his infirmities prevented our taking himself in the party. Shortly beyond Garvin's the road descends into the charming Eden Valley, very similar to the near-by Doyle Valley, both of which contain groves, farms and habitations, yet are really vast sink-holes caused by the ancient caving-in of an immense cavern. This theory is confirmed by our finding several small sink-holes at the bottom of the Eden Valley, into which, it is said, great volumes of water pour after heavy rainfalls, to emerge again in Mammoth Cave and other caverns. Some of these orifices had been closed up, the result being large ponds overgrown by reeds and rushes.

After photographing the new entrance and its environs, we were ready to descend. In doing so we had occasion to observe the outward draft of air that extinguished our lamps, which we lighted again after passing through the gateway. The interior temperature is uniformly 54 deg. F., and the atmosphere has singular opti al and chemical purity. A comfortable stairway and pathway conduct us down 112 feet to the level of the main cave. We step aside midway to inspect a formation on our left, called the Chinese Wall, in a low room 100 feet in diameter, containing a small lake, of which said "wall" is the stalagmitic rim. At a point 200 feet within, a path diverges to the New Discovery, and to the closed entrance from Coates' farm; and the so-called Wild Goose Chase begins 100 feet beyond this.

On our right we found Uncle Tom's Pool, quite pretty, and remarkable for containing the only specimen we saw of the eyeless crawfish (*Cambarus pellucidus*). We were assured that blind fish and other interesting fauna abounded in the river region, which we did not visit. In various parts of the cavern we saw, on the walls and rocks, hundreds of cave crickets (*Hadenœcus subterraneus*), also various flies, spiders and beetles indigenous to the cavern. From our hurried observation we got the impression that the fauna and flora of this cavern were scanty as compared with Mammoth Cave.

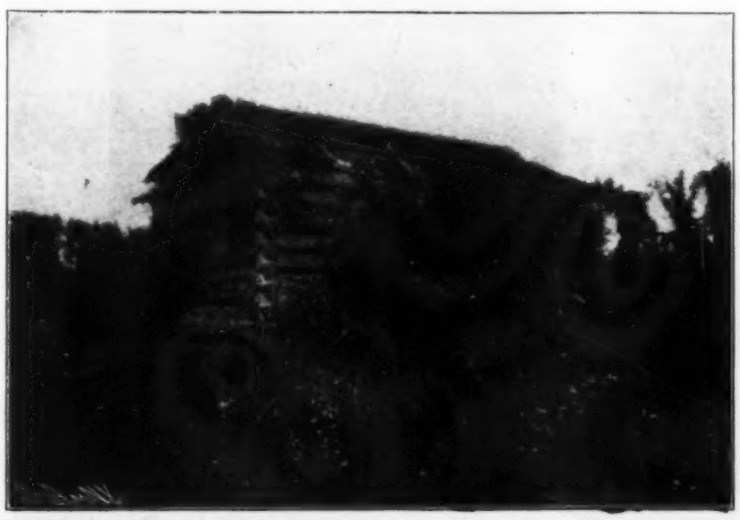
On the left, 150 feet beyond Uncle Tom's Pool, we were startled by seeing, on the farther brink of a spring, an enormous lizard, which proved to be only a grotesque mass of flint, some three feet long, metal-stained, like a lizard in bronze. The canopy over it we named the Saurian Dome. Near Armstrong Pit and the Horseshoe Dome are numerous geodes in the wall, inclosing crystals of quartz and calcite.



MAP OF COLOSSAL CAVERN

Drawn for Hovey's "American Caverns." From survey by Edgar Vaughan and W. L. Marshall. Copyright 1903, by H. C. Hovey, Newburyport, Mass.

1. Chinese Wall. 2. Entrance to New Discovery. 3. Entrance to Wild Goose Chase and River Region. 4. Uncle Tom's Pool. 5. Lizard Spring. 6. Twin Pits. 7. Ruins of Carthage. 8. Rock Island. 9. Sandstone Tumbledown. 10 Ruins of Martinique. 11. Register Avenue. 12. Starry Heavens and Milky Way. 13. Bearskin Robe. 14. Phosphate Mountain. 15. Hull of the Great Western. 16. Catacombs. 17. Pulpit Rock. 18. Cascade Pit. 19. Pearly Pool. 20. Kangaroo Bend.



CABIN IN EDEN VALLEY.

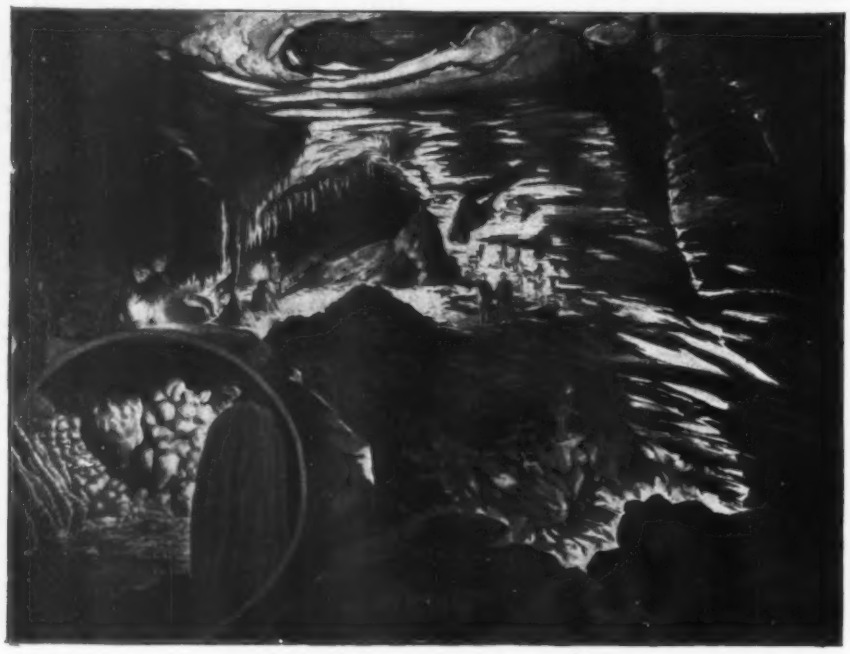
MEADOW SINK-HOLE.

Copyright 1903, H. C. Hovey.

THE COLOSSAL CAVERN OF KENTUCKY.

Fossil corals, known as "zaphrentis," have value in determining the geological horizon of the limestone.

In 1898 Mr. Edgar Vaughan crawled through a small hole on the right, about 500 feet from the entrance, and found it led to an enormous dome now bearing his name. This opening has been artificially



PEARLY POOL; CHAMBER AND SPRING.

enlarged for easy access to the floor of the magnificent vault. The average width of Vaughan's Dome is 26 feet, its greatest width 40 feet, and its total length 300 feet. Mr. W. L. Mapother, adopting my suggestion as to balloon measurements of interior heights (SCIENTIFIC AMERICAN, August 29, 1903), took two hot-air balloons with him, in order to determine the exact height of this dome and the Colossal Dome. His balloons were about four and six feet high. The first, on being released after inflation, shot to the apex of the dome like a rocket, striking with such force as to careen and catch fire, also burning the retaining cord. The second was sent up more carefully, and remained suspended twenty minutes, then gradually descended. The height was found to be 78.7 feet.

We have now a choice between the Main Cave and Florence Avenue, which runs nearly parallel with it for several hundred feet, and finally crosses it on a lower level. Florence Avenue is adorned by richly decorated walls; and mid-way are the Twin Pits and Musical Shower, so called because of the reverberations of a cascade that falls into one of these pits. The Twin Pits are 65 feet deep. The Grand Galleries are in the Main Cave, near where Florence Avenue enters, and the name is given on account of the resemblance of the ledges one above another to a series of theater galleries. The Lovers' Gallery is 400 feet long and 30 feet wide; beyond this is a still grander enlargement of this wonderful cave, styled the Ruins of Carthage, by reason of its resemblance to the ruins of a mighty metropolis. When we took into mind the dimensions of this hall, 400 feet long, 100 feet wide, and 30 feet high, then observed the fact that its nearly flat roof seemed to be one homogeneous block of limestone, and then reflected on the immense mass of rocky strata and forest trees above it, we were amazed that such a roof could support such a superincumbent weight. The only object that at all seems like a support, though it could hardly be so regarded, is a natural pillar at one end of the ruins, to which the fitting name is given of Samson's Pillar, near which the roof curves into a great arch.

In this vicinity we observed many very beautiful saccharine incrustations, as if some candy-maker had flung cartloads of gum-drops and other kinds of confectionery against the walls. Faces and figures, some lovely and others grotesque, stand out from the nooks and corners in startling relief. One that is particularly life-like and lovely, is named Alice Ringgold's Face. The Via Crucis leads to a floral cross. On the Shoemaker's Bench the tools left by Crispin lie carelessly about. Mention might be made of the Devil's Caldron, the Parlor Heater, the Elephant's Head, and many other queer objects pointed out by the guides here and there.

A huge rock, located on the right, just beyond Samson's Pillar, is a remarkable imitation of the stern of an ocean steamer, with her rudder hard aport, though somewhat unshipped. The guide calls this the Great Western. It is almost an exact reproduction of a similar formation in Mammoth Cave, called the Great Eastern.

Tremendous forces have been at work, as is proved by the Ruins of Martinique and the Catacombs. We measured one enormous block 60 feet long, 20 feet wide, and 10 feet thick, like the sarcophagus of an ancient Goliath of Gath. At a point 2,000 feet from the entrance is the Sandstone Mountain, a "tumble-down," where the cave cuts through the St. Louis limestone to the Chester sandstone. On the wall near by we observed an exquisite branching variety of the coral known as Tubipora, 16 inches long by 6 inches wide.

Thus far we have gone in a southerly direction, but now we turn almost due east for some 1,500 feet. Beyond the spacious Auditorium, we note, on the right, Register Avenue, where visitors are allowed to inscribe their names, as if in a rocky album. At the Phosphate Mountain, which the original owner experimented with only to find that it was a false phosphate, the cavern divides around a long "island" 600 feet in length. Near its farther end begins the old Bed-quilt Cave, already referred to, and that stretches away to the northeast for 1,500 feet and then turns westward for the same distance, thus making the surveyed portion 3,000 feet in all. Here and there in it are pits, domes, and other enlargements with now and then a "tumble-down." It is not included in the route over which visitors ordinarily are conducted.

At the termination of the Long Island is the Pulpit Rock on one side and the Dining Room on the other, where visitors may lunch. The ceiling of the Dining Room is as level as if finished by trowel and float. Beyond it is the Bicycle Route, trending to the right for 300 feet and then rejoining the Main Cave.

The crystalline formations are worthy of great admiration. For several hundred feet the roof under whose arch we have been passing is spangled with efflorescences that mimic the starry heavens, with here and there a comet or a meteoric shower. Gypsum crusts were often observed to hang from the ceiling in sections several yards square, seemingly ready to drop if jarred. Straight and curved crystals of selenite abound, the latter being known to the scientist as "oolopholites," but commonly called stone rosettes. These are so abundant and magnificent in one large hall as to have led to its being named the Grand Avenue of Flowers. On the walls single spikes six or eight inches long are frequent, and now and then a

COLOSSAL DOME (FROM THE GATEWAY).

COLOSSAL DOME.

THE COLOSSAL CAVERN OF KENTUCKY.

branching mass of crystals, one or two feet long, like stag-horns. There are often delicate, lace-like formations spread between the clusters of cave flowers. The guide points out what he terms the Bear Robe. It does indeed look like a mass of fur carefully spread on the wall to dry. On inspection we find the robe to be made up of hundreds of crystals of selenite, whose tips are stained by the black oxide of manganese, the body of the fibers being softly tinted with gray, instead of being pure white. About 100 feet beyond the Bear Robe are some fine botryoidal, or grape-like clusters.

Now we find strange ramifications and enlargements, with here and there window-like openings into ghostly chambers, whence weird apparitions seem to arise and beckon us to our fate. Wonders crowd upon us. Descending a flight of stone steps, and turning to the right we climb a steep acclivity named Pike's Peak, while to the left runs a rill named the Spring of Tantalus. We are not responsible for these titles, nor do we feel bound to explain them.

But it is otherwise with a gigantic gateway, 20 feet wide and 60 feet high, to whose majestic arch and buttresses no name had been assigned. Its right-hand support is the largest stalagmitic shaft in the cavern. Its total height is 75 feet. It is a mass of bronze alabaster of unrivaled beauty. Recalling to mind the fact that in all Kentucky's caverns, no recognition had yet been made, so far as I knew, of Kentucky's matchless statesman and orator, I asked and obtained permission from the company to christen this mighty column the Henry Clay Monument. On the left of the gateway is the finest specimen of the synclinal I have ever seen underground, where the thick strata had yielded to the enormous pressure from above, thus being crushed into these reversed arches.

Passing reverently, with bared head, through what reminded me of the Redeemer Gate by which the Kremlin at Moscow is entered, we descended some rude stone steps, winding around the base of the Henry Clay Monument, and suddenly found ourselves in what seemed like open space. Aloft and around us was utter darkness. We were at the lowest level of the cavern, 240 feet vertically below the original entrance. Our torches did little more than to make the darkness visible. Mr. Fowke's acetylene lamp threw a ray of light across to the farther wall 56 feet distant but flashed upward in vain. Lighting some magnesium ribbon—of which every cave hunter should have a supply and that can be ignited by a match—we caught a glimpse of the apex of what the guides now told us was the Colossal Dome, the grandest room in all this temple of silence and of night. Mr. Hunt's ingenuity, however, devised a unique and satisfactory method of illumination. The reader will remember that early explorers used to be lowered by windlass and rope from that same apex. The rope had been removed; but a cord took its place, both ends of which were lowered to the floor of the dome. To one of these ends was attached a wire cord holding a fire-basket, which we filled with oiled rags, chemicals, and a quantity of magnesium ribbon. Then igniting the mass of combustibles, we pulled on the other end of the cord, and hoisted the huge fire-ball to the apex. This made visible the snow-white fungus, many feet long, waving from below the decayed bridge. Large drops of water fell like shot from the tip of the dome to the floor, sparkling like gems as they fell, and adding their music to the majestic occasion. We tried to imagine how it would seem to have a winter cascade come thundering down for 135 feet on the rocks where we stood, as it is said to do in the rainy season. We raised and lowered the glowing fire basket at will, thus displaying to advantage the series of immense rings, each eight or ten feet thick, that make up the walls. These rings are differently tinted, and some of them are finely fringed with stalactitic drapery. Taken as a whole, the Colossal Dome is grander and more symmetrical than any other of which we have knowledge, and it perfectly satisfies one's idea of the utmost subterranean grandeur.

The Pearly Pool route is entered by a tunnel 60 feet long. We pause a moment on the verge of a pit 88 feet deep, about which are many fine stalactites, some of which grotesquely resemble various birds and beasts. I remember a quail that was extremely lifelike. Long ago a huge stalactite fell with its tip under the drippings of a cascade, which left on it a rich nacreous incrustation. The basin, three or four feet wide, that catches these waters is the Pearly Pool, and glistens with hundreds of cave-pearls. Some nameless and graceless scamp struck his hammer into it, making an outlet for the water and ending the pearl-making process.

The Kangaroo Bend opens into the Snowy Valley, 600 feet long, where there are fine gypsum formations. It ends in a "tumble-down," where flow copious chalybeate springs over iron-stained stalagmites. The water is palatable and has valuable medicinal properties.

It only remains to add a few words about the New Discovery, that begins near the mouth of the cave, and has been surveyed for 2,000 linear feet. But so much of it requires one to go in a stooping posture, or on his hands and knees, that it seems thrice as far. Yet the patient explorer is rewarded by finding a region utterly unlike anything known in other caves in the vicinity, though we have seen similar localities in the Wyandotte Cave, in Indiana. The bed-rock is a fine-grained magnesian limestone, which seemed to me suitable for lithographic use. The officials have since tested the material practically to their satisfaction. For many hundred feet the path has been artificially cut through this rock. On every hand we behold on walls and roof the most charming rosettes and intricately convoluted helictites. The fact that no names have yet been given to particular places and formations makes description difficult. Helictite Chamber and Rosette Chamber are so called on account of the abundance of the curious formations thus indicated. Indeed, the New Discovery is not yet open to the general public, partly because it is not easy of access, and partly because of the facility with which the natural ornaments could be mutilated by careless or covetous hands. It is a perfect flower-garden, where the excited fancy finds in unsullied loveliness a crystal reproduction of every floral gem of the conservatory or parterre. It is to be hoped that this wilderness of beauty may be made accessible and also safe from spoliation.

As there are obstacles at present in the way of successful photography in the Colossal Cavern, the accompanying drawings, made by F. W. Cawein, artist, of Louisville, Ky., are available by the courtesy of the Robert Clarke Publishing Company, of Cincinnati.

THE CAMPHOR INDUSTRY OF FORMOSA.*

By A. FREDERICK COLLINS.

NATURAL camphor is procured by distillation from the wood, roots, and leaves of the camphor tree. It grows in Southeastern Asia and in Japan, but by far the largest part of the camphor of commerce comes from the island of Formosa, the area of production being limited to a narrow belt of debatable land separating the Chinese settlement from the aborigines.

Between these two elements of the population there is no love lost, and often it is the bitterest feeling which prevails, so that the production of camphor under the old *régime* was attended with considerable danger.

The methods employed, too, were most primitive and of the crudest kind. A great wooden trough made from a hollow log and protected by a covering of clay is placed over a slow fire. Water is poured into the trough, serving as a still, and it is then covered over by a board, filled with holes, through which the steam from the trough escapes. Over these orifices chips of the camphor tree are placed and covered by earthen pots. The vapor of water arising carries up the camphor, which condenses on the inner surface of the earthen vessels as minute white crystals. It is then collected and stored in vats to await exportation, during which time it gives off from three to four per cent of uncrystallized camphor oil of a yellowish color, somewhat resembling turpentine, and, it has been suggested, might be used as a substitute for spirits of turpentine.

The condition of affairs and the process just described were in force until a few years ago, when by the fortunes of war Formosa fell into the hands and care of Japan. This progressive government immediately saw the possibilities of a considerable revenue from the camphor industry, and for this reason, as well as for the purpose of perpetuating the forests, which were threatened with destruction because of the senseless and wanton felling of the trees—the Chinese often using the precious wood as fuel—established a monopoly of the camphor production. The first act toward its consummation was the elimination of the long-waged warfare between the natives and the Chinese; then fifteen hundred Japanese soldiers were placed to patrol and police the productive district, and finally forestry laws were passed and rigidly enforced looking to the perpetuation of the rapidly disappearing camphor trees. These were no longer to be wantonly felled, no camphor-bearing material was to be used as fuel, and for every tree destroyed in the prosecution of the industry a young tree must be planted and raised in its stead.

The rude methods practised by the natives and Chinese were displaced by modern methods, and all the procedures of a monopoly were speedily executed. China was never able to furnish more than two hundred thousand pounds of camphor a year. Japan proper produced about three hundred thousand pounds; but Formosa under the new management is now turning out annually approximately seven million pounds. From these figures it is apparent how absolute Japan's control of this trade is. So long as her laws are complied with, any one may collect camphor gum and prepare it for market, but it can be sold only to the government.

For this purpose offices are established throughout the camphor district, with headquarters at Taipeh, the capital. Here is located the so-called "camphor factory" built by the government. It is the most imposing in appearance of any of Formosa's industrial establishments. It comprises one main building containing the distilling apparatus for grade A camphor, one building equipped with the necessary apparatus for the extraction of camphor from the camphor oil, a long warehouse for storing the drug, a packing house, and numerous smaller houses, including barrack-like quarters for the laborers and neat little cottages for the officers and skilled workmen.

The factory buildings are big, solid structures of brick and stone, and are provided with not only the latest approved hydraulic and steam-pressing machinery, but with much apparatus specially designed for the work. The grounds and buildings are illuminated by electricity supplied by the factory's own plant. The buildings impress one as being erected with the idea of permanency, and the government hopes to control the camphor situation for a long time.

Camphor in the Orient is now obtained by steaming camphor wood in roughly built furnaces set up in the hill districts. As in the earlier methods, snow-like deposits of camphor are found by steaming the wood, the vapor of which condenses in cooled wooden receptacles. The camphor thus obtained, however, contains a considerable quantity of oil. After removing the camphor from the condenser, it is allowed to drain into tubs until a large portion of the oil has run off. The camphor is then packed in canvas bags and transported to the central office at the capital. That which is designated for shipment as crude is not subject to any further treatment after leaving the country districts. For transportation it is packed by hand in zinc-lined cases holding about one picul—equivalent to one hundred and thirty-three pounds English weight. This is designated as grade B and is similar in form to the crude camphor product exported prior to the establishment of the monopoly, although the government has been able to effect a slight improvement in quality. For the production of grade A the camphor is treated and refined at the factory described above. The plant possesses six large distilling furnaces measuring 16 by 12 by 24 feet, and two crystallization chambers 30 by 24 by 24 feet. Several thousand pounds of the crude camphor are placed in the large iron retorts, and after the openings in the latter have been closed and sealed air is forced in to hasten evaporation. For the first forty-eight hours a slow fire is maintained, raising the temperature sufficiently to drive off the water and oil, forcing them through a pipe leading from the top of the retort into a water-cooled tank. The heat is now increased and the drain is shut off. The orifice of a second pipe is opened and the camphor fumes pass through it to the crystallization chamber, the roof of which is cooled by running water. Here the substance crystallizes to flowers of camphor, when it is ready for pressing.

This process is accomplished by first shaping the camphor into blocks by the use of wooden molds, then pressing it by steam power, and finally applying a very high hydraulic pressure. The result is a hard, almost opaque brick of practically pure camphor, weighing ten kiu, or 13½ pounds. These blocks are wrapped in oiled paper and packed in zinc-lined boxes holding ten blocks each, and, after receiving the government label, "crude camphor pressed by the Formosa government," are handed over to the selling agent.

In the current issue of the SCIENTIFIC AMERICAN will be found an illustrated account of the making of artificial camphor—an industry that promises to become a rival to that of Formosa.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

AN EXPERIMENTAL INVESTIGATION OF THE PRESSURE OF LIGHT.*

By PETER LEBEDEW.

KEPLER was probably the first (in 1619) to attribute the form of comets' tails to a repulsive force from the sun, and to explain this repulsion as the result of the pressure exerted by the sun's rays on the matter in the tail. The same phenomenon also led Euler, in 1746, to ascribe a pressure to the solar radiation, and in 1754 De Mairan made the first attempt to test these ideas experimentally, but he did not obtain a positive result.

A duel theoretical basis for the pressure of radiation was independently and almost simultaneously given by Maxwell in 1873, as a consequence of the magnetic theory of light, and by Bartoli in 1876, as a consequence of the second law of thermodynamics.

If a beam of parallel rays is normally incident on a plane surface, the amount of the Maxwell-Bartoli light-pressure p is determined if we know the quantity of energy E received per second, the reflecting power ρ of the surface, and the velocity v of light. For then

$$p = \frac{E}{v}(1+\rho)$$

where ρ varies between 0 for an absolutely black surface and 1 for a perfectly reflecting surface.

This pressure is very small; for solar rays falling normally at the earth's distance upon a square meter, the pressure exerted is 0.4 milligramme for a black surface and 0.8 milligramme for a mirror.

In the experimental investigation of the pressure of light two large sources of disturbance arise, the one due to the well-known radiometric forces discovered by Crookes and the other to convection in the residual gas. It is possible, however, to diminish these disturbing forces and to make their effect on the observations harmless, if the experiments are made with very thin metal vanes and the exhaustion is carried as far as possible by using a mercury pump and condensing the mercury vapor by freezing mixtures.

Without entering into the details of the experimental arrangements, the principle of the method employed may be briefly explained as follows: A torsion thread hangs in a highly exhausted bell jar and carries a vertical glass rod. Thin disks of 5 millimeters diameter, of the metal to be investigated, are attached to this rod at a distance of 10 millimeters from its axis. If the radiation from an arc lamp is concentrated on one of the disks the incident radiation will exert a pressure upon it, and it will retire until the pressure due to radiation is balanced by the torsion of the glass thread; the angle of torsion is measured by a mirror and scale as for a galvanometer. This observation permits the determination of the absolute magnitude of the pressure (in dynes) if the directing force of the torsion thread is measured in absolute units by one of the well-known methods.

In order to compare the observed pressures with those computed, according to Maxwell and Bartoli, from the amount of energy incident and the reflecting power of the vane used, the same beam of light was directed upon a circular aperture of exactly the same size as the vane, and the rays passing through were caught by a calorimeter. If we divide the quantity of energy incident per second, as measured by the calorimeter, by the velocity of light, we obtain the amount of pressure in dynes exerted by the light upon a perfectly absorbing body, according to Maxwell and Bartoli.

The measurements which were made repeatedly and with different apparatus yielded accordingly the following results:

Vane used.	Radiation observed.	Pressure computed.
Black platinum plated.....	1.1	1.0
Bright platinum.....	1.8	1.6
Bright aluminium.....	2.0	1.8
Bright nickel.....	1.4	1.6

For such complicated and difficult measurements a better agreement between observations and computation can not be expected. A discussion of the possible errors of observation shows that they are considerable, but that within the limits of error the existence of the light pressure of Maxwell and Bartoli are quantitatively confirmed.

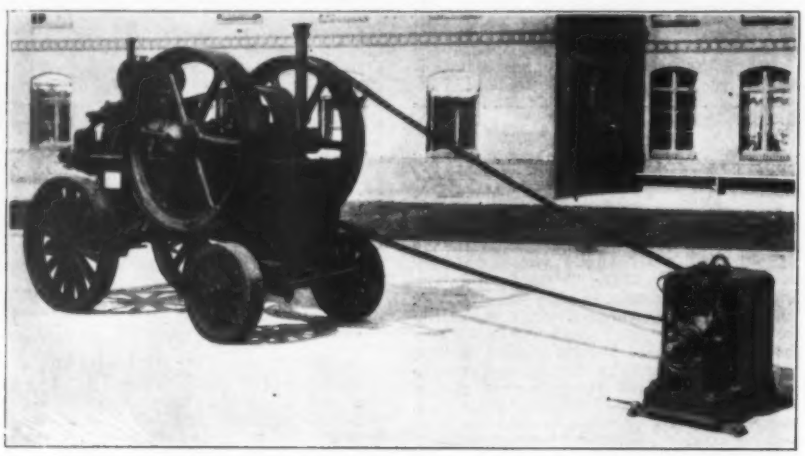
This result is of importance to astrophysics as furnishing a much simpler explanation of the repulsive force of the sun than the hypothetical ones of electrical charges. A firm basis, amenable to computation and assured by experiment, is thus given to the view expressed by Kepler.

Physical Institute, Moscow, November, 1901.

* From the Astrophysical Journal. Translated from an abstract, communicated by the author, of his extended paper in Annalen der Physik, vi, 433-458, 1901.

TRANSPORTABLE GENERATORS OF ELECTRICITY WITH ALCOHOL MOTORS.*

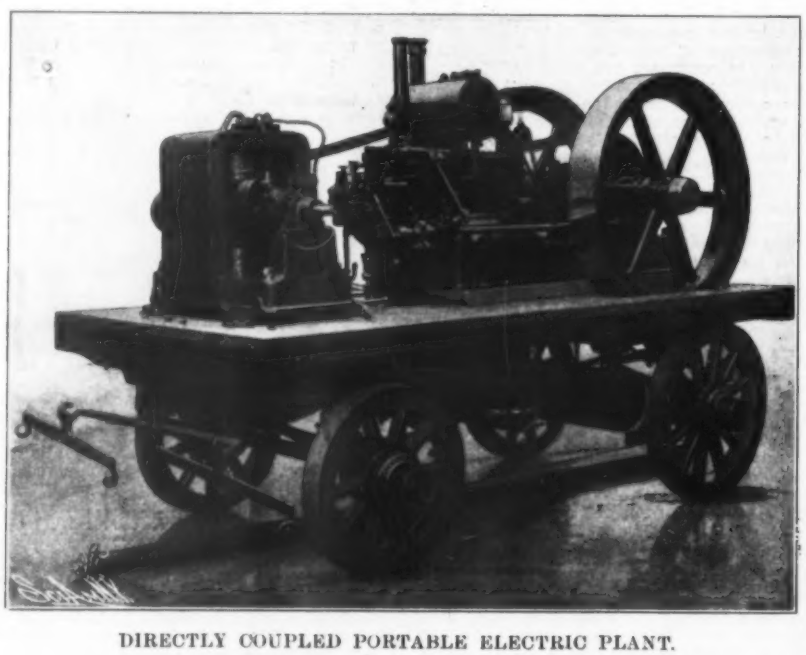
LIQUID fuel motors are becoming more and more widely employed on account of the quickness with which they may be set in motion, of the ease with which they may be moved about, of their relatively low cost of maintenance, and sometimes also of the small quantity of water that they consume as compared with a steam engine of the same power. The fuel employed



PORTABLE ELECTRIC PLANT, WITH MOTOR AND DYNAMO SEPARATE.

is, moreover, very variable—sometimes kerosene and sometimes gasoline. Such motors are especially adapted for the establishment of transportable groups of electric generators, and surpass steam motors by the facility with which fuel may be obtained and carried to them.

In recent times, alcohol motors have been coming into great favor, in Germany especially, for the establishing of traveling groups of generators of electricity. Their easy and regular running perfectly adapts them for the driving of dynamos; and the relatively low cost of alcohol at Berlin permits medium-sized, or small installations, to produce for themselves the electric energy that they require for lighting or motive power. The alcohol dynamo, in addition to its use in small industrial installations, may be employed in agricultural exploitations, and, in general, everywhere where a source of energy is to be utilized only temporarily in the same place. Traveling groups of electric generators are particularly well adapted for this kind of service. Those constructed by the Lakmeyer establishment of Frankfort, and illustrated herewith, furnish a good example of them. The electricity generating group is sometimes stationary and direct connected, and sometimes the motor is placed upon a vehicle and drives the dynamo through the intermedium of a belt, and then again the motor and dynamo are mounted upon one and the same vehicle. The type in which the motor is not directly coupled to the dynamo has the advantage of permitting of the use of the former for driving other machines, while that in which the motor is completely separated from the dynamo permits, if need be, of utilizing the latter as a motor for other machines when the portable plant is at a place where electricity already exists. The reservoir, as a measure of precaution, is arranged beneath the



DIRECTLY COUPLED PORTABLE ELECTRIC PLANT.

vehicle, and thus occupies less space. The power of these electricity generating groups varies from 2¼ to 40 kilowatts. Their total weight is from 1,030 to 4,970 pounds. The number of revolutions varies from 660 to 750 according to the power developed.

Waterproofing of Shoes.—In 16 parts of olive oil, dissolve 4 parts of tallow, 1 of spermaceti, and 1 of wax, and apply to the footwear.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

CONTEMPORARY ELECTRICAL SCIENCE.*

EFFECT OF HEAT ON RADIO-ACTIVITY.—Fanny C. Gates has obtained another proof that excited radio-activity cannot be destroyed by intense heat. If the excited radio-activity is not destroyed by intense heat, it was argued that by heating a radio-active platinum wire inside a closed vessel so as to prevent all escape, the active particles, although removed from the wire, would still remain and might be discovered in the surrounding air or on the walls of the vessel. For this purpose, a hollow brass cylinder, about 10 inches in length and 3 inches in diameter, was fitted with ebonite ends; in each end were two openings, one in the center through which to pass the wire, and another through which to send a blast of air when desired. The wires used were 6 inches in length and about 1-20 inch in diameter. The cylinder was used in the usual manner, as a testing vessel for measuring the amount of radio-activity within it. Its outside was joined to one terminal of a storage battery of 100 volts, and the central wire to one pair of quadrants of an electrometer of which the other pair was connected to earth. Another testing vessel was used for comparing the amounts of activity produced by the wire before and after heating. The wire was excited by making it the cathode of a P. D. of 100 volts, and placing it for several hours inside a closed metal box containing 50 grammes of thoria. When placed in position in the cylinder, an ionization current of the order of 10^{-11} amperes was produced. A current of 20 amperes was then passed through the wire, heating it to incandescence, after which the ionization current was again measured. Instead of showing a great loss, as might have been expected, the current was nearly as large as before; upon replacing the platinum wire by an inactive copper wire but little further change was observed. The platinum wire was then put in the second testing vessel, and found to possess only about 3 per cent of its original activity. Clearly, then, the active particles had been removed from the wire, and were still inside the cylinder. The air was then blown out, but no decrease in current was thereby obtained, showing that the active particles had become attached to the inside surface of the cylinder. The rate of decay of the radio-activity within the cylinder was observed and found to be such that it was reduced to half value in 11 hours, the characteristic of excited radio-activity from thorium. These results show that intense heat does not destroy excited radio-activity, and that under conditions as here described the active particles are transferred at a definite temperature without other change from the platinum wire to the inside surface of the cylinder by a process of volatilization.—F. C. Gates, Phys. Rev., May, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

CONDENSATION OF RADIO-ACTIVE EMANATIONS.—E. Rutherford and F. Soddy have made the interesting discovery that the radio-active "emanation" from thorium or radium is a vapor possessing definite points of condensation and vaporization. If either emanation is conveyed by a slow stream of hydrogen, oxygen or air through a metal spiral immersed in liquid air, no trace of emanation escapes in the issuing gas. When the liquid air is removed and the spiral plunged into cotton wool, several minutes elapse before any deflection of the electrometer needle is observed, and then the condensed emanation volatilizes as a whole, and the movement of the electrometer needle is very sudden, especially in the case of radium. If the radium emanation is condensed in a glass U-tube, the progress of the condensation can be followed by the eye by means of the fluorescence which the radiations excite in the glass. If the ends of the tube are sealed and the temperature allowed to rise, the glow diffuses through the tube, and can be again condensed at any point by applying a pad of cotton wool soaked in liquid air. The authors determined the boiling points of the two emanations by cooling them in a copper spiral which acted as its own resistance thermometer. The boiling point of the thorium emanation is —120 deg., and of radium emanation —150 deg.—Rutherford and Soddy, Phil. Mag., May, 1903.

POLONIUM RAYS.—Polonium rays differ from radium rays inasmuch as they contain no cathode radiation. It has hitherto been assumed that polonium only emits canal rays—i. e., positive ions suffering only slight deflection by a magnet and undergoing absorption easily; in other words, heavy particles of considerable momentum, but small free path. H. Becquerel has now discovered another form of radiation, of high penetrative power. On a sensitive plate entirely covered with a thin plate of mica, a piece of metallic polonium was placed. At a distance of 2 centimeters from the polonium a leaden gutter was placed pierced at several places with windows containing aluminium or copper. On developing the plate after a ten days' exposure, a black spot rather larger than the polonium piece was found just under it. A black space was also found under the lead gutter. Since the ordinary polonium rays are incapable of penetrating mica, the author concludes that the black spots must have been due to some more penetrating type of rays, which do not act directly upon the plate, but produce photographically active secondary rays where they leave the mica. Polonium would therefore possess two out of the three forms of radiation exhibited by radium, and would only lack cathode rays.—H. Becquerel, Comptes Rendus, April 27, 1903.

AN OSCILLATING-CURRENT INDICATOR.—A. Winklemann describes a pretty instrument for demonstrating the existence of oscillatory currents and discharges. It consists of two vertical vacuum tubes mounted side by side and connected by a cross-tube. The tops of the tubes contain electrodes, and a mineral is mounted on a glass support in the center of each bulb. The mineral is corundum in one bulb and scheelite in the other. It is well known that under the influence of cathode rays the former mineral shines with a red light, while scheelite takes a blue color. On passing a current from one electrode to the other, it is easily observed which is the cathode, since the mineral under it shines out. When the current is oscillating, they both shine out. To show the transition from one type of discharge to the other, the two electrodes are joined to the terminals of an influence machine. If the discharging rods are pulled so far apart that no oscillations take place, the discharge is continuous. When the rods are near enough to let sparks pass, both crystals shine out. A small induction coil driven by a single accumulator cell suffices.—A. Winklemann, Zeitschr. für Instr., May, 1903.

DESTRUCTION OF A TELEPHONE CIRCUIT BY LIGHTNING.—P. David describes a curious accident which happened to a telephone connecting the Puy de Dome Observatory with the dwelling house of the meteorologists. The telephone had no complete metallic circuit, but was earthed at the dwelling house and connected with the earth anemometer mast at the observatory. During a violent hailstorm a lightning discharge struck the anemometer and passed along the telephone wire, cutting it in two places underground and fusing a lead pipe near the house. The electric telephone bell in the observatory was badly damaged, the coils being cut along a generator of the cylinder. The author points out that the circumstances realized a particular case of Lodge's dynamic discharge. The rock on which the observatory stands consists of badly conducting material. The anemometer could thus acquire a static charge through the telephone wire. The static discharge following produced a dynamic discharge in the circuit containing the inductance of the bell and a capacity represented by the telephone wire passing close to the earthing wires of the other instruments in the dwelling house.—P. David, Jour. de Phys., May, 1903.

ZEEMAN EFFECT.—A. Gray and W. Stewart have made some experiments with a view to determining for as many lines as possible of different substances, the proportionality of the change $d\lambda$ of wave-length, for each of the components into which a single spectral line is resolved by the application of a magnetic field, to the field intensity H, and to deduce the corresponding values of the ratio e/m of charge to mass of the electron. Up to the present, the observations have been mainly of the spectra of helium and mercury, the line chosen in the case of the latter being the green line 546·1 $\mu\mu$. They used an echelon spectroscope consisting of 26 plates 1 cm. thick, with a width of step of 1 mm. The source of light was an exhausted tube, containing the vapor the spectrum of which was under examination, provided as usual with terminals and joined up in the secondary circuit of an induction coil; the capillary part of the tube was placed between the poles of the electro-magnet. The first observations were made at right angles to the magnetic field on several of the helium lines, and on the green line of mercury. In every case the normal triplet was obtained, and the separation between the extreme components found to be

proportional to H up to fields of 10,000 C. G. S., beyond which it was difficult to obtain readings. The ratio e/m was found to be $12{\cdot}1 \times 10^6$ for the green helium line and $13{\cdot}4 \times 10^6$ for the green mercury line. When, with the green line of mercury under observation, the field strength was increased to 13,000 C. G. S. the center component of the normal triplet was doubled, while each of the outer components was itself tripled. The polarization of the two triplets and of the central doublet was the same as that of the lines from which they originated, namely, that of the lines of the normal triplet. At all fields up to 13,000 the faint companion to the yellow helium line D_2 was not tripled, but only doubled. Observations along the lines of force gave $13{\cdot}1 \times 10^6$ for the green helium line and $12{\cdot}0 \times 10^6$ for the green mercury line.—Gray and Stewart, Proc. Roy. Soc., May 14, 1903.

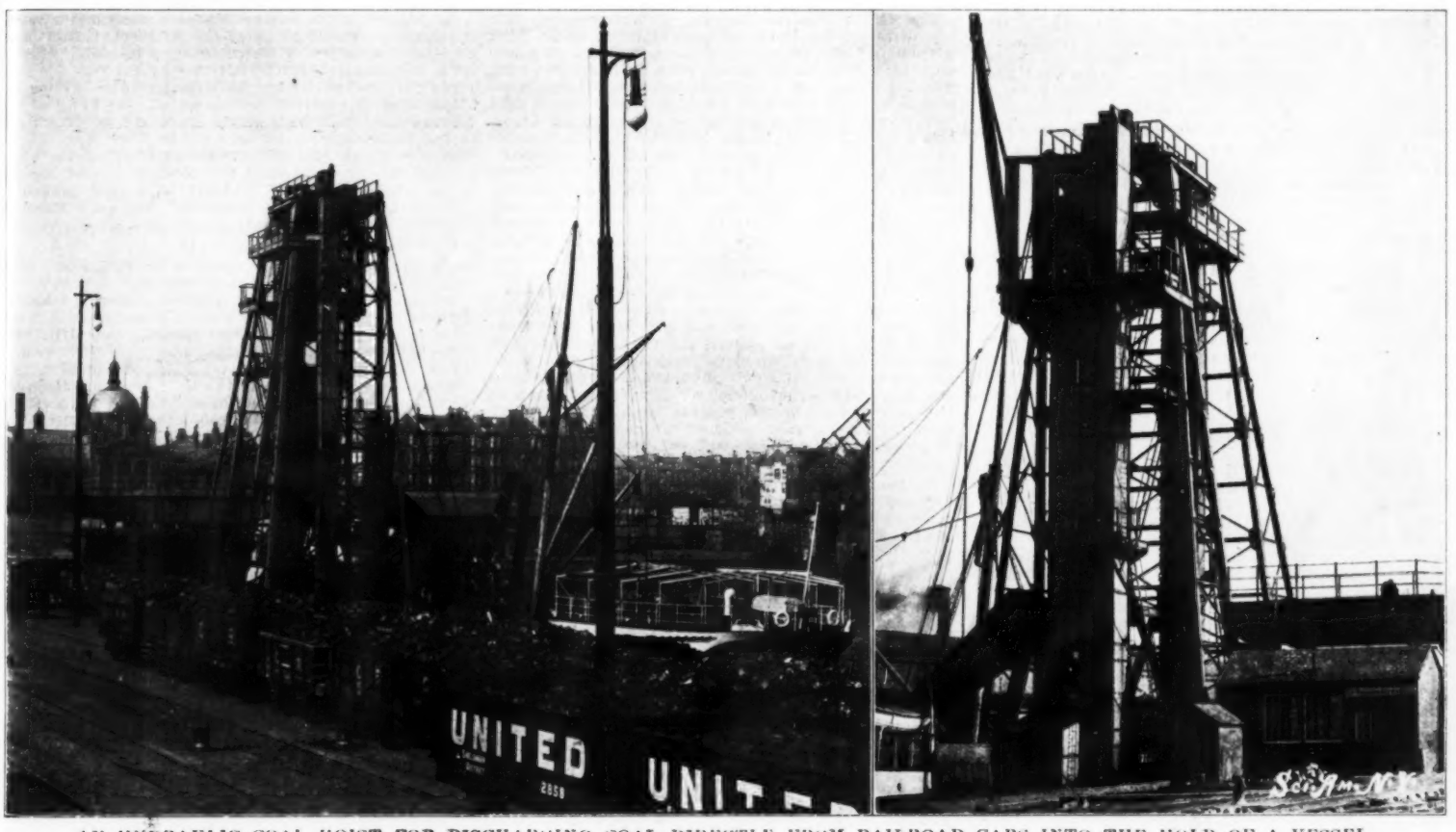
HYDRAULIC COAL HOIST FOR DISCHARGING COAL INTO SHIPS' HOLDS.

THERE has recently been installed at the Prince's Dock, Glasgow, a hydraulic coal hoist for discharging the coal direct from the railroad cars into the hold of a vessel moored alongside. The hoist has been constructed to the order of the Clyde Navigation Trust by Sir W. G. Armstrong, Whitworth & Co., Ltd., of Newcastle-on-Tyne, and it contains several interesting features. The hoist is of the suspended pattern, in which everything except the holding-down bolts is kept above the level of the quay, and which only requires as a foundation a solid block of concrete or masonry of sufficient size to take the base of the framing.

The hoist is arranged to lift cars of a gross weight of 25 tons to a height of 50 feet above the quay. The loaded wagons reach the hoist at quay level, pass over a turntable and weighing machine, and after being lifted to the height required for discharging into the shoot, the empty wagons are lowered to the level of an elevated inclined gantry, by which they are run away to the empty side tracks under the influence of gravity. A weighing machine is also provided on the high level adjoining the hoist for re-taring the empty wagons.

The hoist itself consists of a braced steel framing secured to the quay by holding-down bolts. This framing forms the guides for the cradle on which the truck is lifted, and which is fitted with a tipping frame by means of which the wagon can be tipped to an angle of 45 deg. at any point in the lift of the hoist. The wagon when tipped discharges its contents into a shoot on the front of the framing, which is so arranged that it can be adjusted to suit the level of the ship being loaded. The heel end of the shoot is carried by brackets and pawls taking into racks on the front pillars of the framing, safety chains being also provided in case the pawls become disengaged. The point of the shoot is supported by chains leading over pulleys on the top of the hoist framing. When not in use, the shoot point is tipped up, so as not to be in the way of vessels lying alongside. The point of the shoot is fitted with a pair of hinged doors for controlling the flow of the coal, and a removable lengthening piece for fitting on to the end of the shoot is provided. The adjustment of the shoot is effected by making a temporary attachment of either the heel or point or both to the lifting cradle. The lifting and tipping of the cradle is effected by hydraulic cylinders placed vertically on the side of the framing with the rams working downward, one of the lifting cylinders being in constant communication with the pressure mains, so as to economize power when lowering the empty wagons.

The cradle and tipping frame are suspended by chains passing over pulleys on the top of the framing to the lifting cylinders already named. On one side of the framing is an auxiliary or anti-breakage crane having a lifting power of 4½ tons, by means of which a box can be filled at the point of the shoot and lowered down into the bottom of the ship and there discharged. This latter operation is repeated until a cone of coal is formed in the hold of the vessel up to the level of the hatchway, to which the point of the shoot is also adjusted. This in the case of tender coal reduces the breakages in shipment, as after the coal is once formed, coal can be tipped directly from the wagon, without there being any fall from the shoot point. The crane is filled with hydraulic lifting and turning machinery. The hoist has proved highly satisfactory in operation, and recently loaded at the rate of 45 wagons per hour into a fairly large vessel. All the motions of the hoist and anti-breakage crane are controlled by one man from the elevated cabin on the side of the framing.



AN HYDRAULIC COAL HOIST FOR DISCHARGING COAL DIRECTLY FROM RAILROAD CARS INTO THE HOLD OF A VESSEL.

PROPAGATING OYSTER GERMS.

AFTER years of vain effort science has conquered the art of propagating artificially the toothsome oyster. With part of the money coined from propagating trusts, New Jersey has solved a problem which promises to pay hugely wherever salt water exists in the United States.

As is the case with many abstruse scientific questions, the oyster cultivation has been worked out in mean quarters. New Jersey's laboratory consists of a rickety little cabin, that looks as though the first heavy wind would blow it over and the first high tide would wash it away. In this little cabin—shanty would be more appropriate—Prof. Julius Nelson, biologist for the State Bureau of Shell Fisheries, which came into being only last winter, has worked out the method of producing and propagating oyster germs or seeds. Close by the laboratory is the professor's "home," another shanty of one room—kitchen, dining room, and bedroom, all in one. Not even a chair adorns these quarters. The professor finds a box the most comfortable object to sit on, while a rough board table serves as a stand for his microscope and glass vessels in which he gathers oyster germs. At every high tide the water floods the laboratory, but settles through the sand floor and passes off quickly. Such is the place in which one of the problems of modern science has been solved. The propagation of oysters is equally simple, despite its puzzling features, and much more interesting.

One of the first objects that strikes the eye on entering the laboratory is a common chicken-egg incubator. "You see," said Prof. Nelson, "the nights are frequently cold. It may be 80 or 90 degrees at noon, and before the next sunrise it may fall below 60 degrees. Now, in nature, the oysters are in water which is almost stationary in temperature during the twenty-four hours, say 75 or 80 degrees, so I have had to install an incubator and keep the temperature about 80 degrees all night long."

The professor deftly opened several oysters like a born oysterman. He selected the most "milky," plunged the point of his knife into their sides, and smeared a drop of this "milk" on a glass slide. The microscope revealed tiny eggs, somewhat resembling oyster shells in their outline, only not so flat. They were so small they could scarcely be seen with the naked eye. Prof. Nelson wiped off the point of his knife with a little sea water just after jabbing it into the male oyster and next into the female, until the water looked as if milk had been added.

Ten minutes later he declared fertilization had been completed.

"A couple of hundred sperms, more or less," he said, "will fasten to the egg, but microscopic study reveals that if more than one enters the egg the result will be a monstrosity that will fail to develop."

Drawing off the spermatized water, Prof. Nelson put it into clear water, repeating the operation several times. The zone occupied by the eggs could be seen as they slowly settled at a rate of one inch every five minutes. In about an hour at a temperature of 80 degrees the first development of the egg begins. It consists of the egg pinching off the bud, which, however, still sticks fast. Soon a pair of buds appear, and later each part pinches into two, and so until the egg looks much like a mulberry or raspberry in form.

In about five hours this little egg or embryo oyster will begin to spin around. A drop of highly magnified water reveals thousands of these tiny little oyster "fry" swimming about. In about twenty-four hours they begin to get shells on them. They then stay near the bottom of the glass, forming layers. So sturdy are the shells thus quickly formed that they can be heard grating against each other when stirred.

At this stage of the development, the embryo oysters begin to feed. Hitherto they have lived on the nutriment stored within the eggs themselves. What food is uneaten decays and kills the oysters unless they are removed. Prof. Nelson has devised a little shallow or "claire" as he terms it, a sort of harbor dug out of the bank of the creek, which runs past the laboratory, and covered with a roof. The bottom is covered with sand and is so high as to be exposed at every low tide. This is to renew the water with each tide, but there is enough left to keep the fry alive.

At this juncture of the oyster's development, Prof. Nelson has encountered one of his hardest problems—that of keeping the tiny "fry" from escaping from the "claire." He is working at present to perfect the gate which he now uses. The finest bolting cloth he could obtain was too wide in mesh to retain the oysters. He finally hit upon a gate made of absorbent cotton quilted between two sheets of wire netting, but it is unfortunately too tight to allow the water to pass through it freely and still retain the oysters. The manufacture of a proper gate is the problem laid out for next summer.

"The difficulty hitherto has been to raise oyster fry in abundance that would live on until they got their shells, but now I believe this has been mastered," said Prof. Nelson. "The oystermen want me to supply them with spawn guaranteed to 'set' on their shells, planted in their planting grounds. In other words, they want seed by the bucketful instead of by the bushel.

"One bucketful should contain enough embryos, if all live, to supply all the seed a man would need, but the difficulty would be to distribute it just at the moment it was going to set and distribute itself evenly on the thousands of bushels of shells. But that is a matter easily remedied."

With the problem of raising the embryo worked out, the propagation of the bivalve, in which New Jersey has over $2,000,000 invested, and Delaware, Maryland, and Virginia, and several other States an equal amount, has been successfully solved.—N. Y. Times.

Varnish for Pianos and Other Furniture.—We speak of pianos particularly, because the cases of these require an extremely fine varnish. This is an alcohol varnish made by dissolving 1,000 parts of 95 per cent alcohol, 65 parts of mastic, and 250 parts of shellac. When the solution is complete, it is well to shake it, after adding a tenth of its volume of benzine. It is left at repose for a few hours and decanted to remove the benzine.

TRADE NOTES AND RECIPES.

Remedy Against Mites and Ticks.—We have already recommended formol for this purpose. The following mixture may also be employed: Dissolve in 500 parts of alcohol, 10 of naphthalene, 10 of carbolic acid, 5 of camphor, 5 of citron, 2 of oil of thyme, 2 of lavender oil, and 2 parts of savinier oil.

Cleaning of Marble.—Take 2 parts of sodium bicarbonate, 1 part of powdered pumice stone, and 1 part of finely pulverized chalk. Pass through a fine sieve to screen out all particles capable of scratching the marble, and add sufficient water to form a pasty mass. Rub the marble with it vigorously, and end the cleaning with soap and water.

Process for Bleaching Tallows and Fats.—Instead of exposing to the sun, which is always attended with danger of rendering fats rancid, it is better to liquefy these at a gentle heat, and then add one-fifth in weight of a mixture of equal parts of kaolin and water. The fatty matter should be worked up for a time and then left to separate. Kaolin has the advantage of cheapness in price and of being readily procured.

To Attach Paper to Fabrics and to Metal.—M. Jenke recommends the application of gutta-percha sheets for this purpose, simply by means of heat. Between the paper and the fabric, a thin sheet of gutta of the same size as the paper is introduced. This is protected by another leaf of paper, which will be sacrificed. Pass a very hot iron over the whole. The gutta will be partially melted, and the paper adhere closely.

Formulas of Cold Creams.—First Formula: Mix 425 parts of almond oil, 185 parts of lanoline, 62 parts of white wax, and 62 parts of spermaceti. Work them up until a homogeneous mass is produced. Make separately a solution of 4½ parts of borax in 300 parts of rose water, and incorporate the solution in the creamy mass. Second Formula: Mix 125 grammes of gum adraganth and 100 grammes of boracic acid in 140 grammes of glycerine. Add 50 grammes of almond oil, 50 grammes of glyconine, and 5 decigrammes of avender essence. Incorporate them well. Afterward add water in successive quantities, so as to make up a total weight of 1,000 grammes for the production of a clear jelly of good consistency.—La Nature.

The "Boreol" Freezing Salt.—When ice is not at hand, freezing mixtures are convenient. But it is generally necessary to unite several chemical products in exact proportions, and this is not always convenient. To remedy the trouble, M. A. Desmarest has produced a single salt obtained by boiling a sodium salt at 120 deg. C., of which the freezing power is considerable. It is sufficient to mix it with 60 per cent of water in order to obtain a bath of a temperature sixteen degrees C. lower than that of the water employed. This crystallized product, which is called *boreol*, contains no trace of ammonia, is odorless, and can be preserved indefinitely. With 1 kilogramme of boreol it is possible to cool about 3 liters of water to a temperature of +10 deg. C.

Powder for Increasing the Egg Production of Poultry.—There should be no illusion. Every time that this is accomplished by artificial means, the increase of the product is gained by the loss in duration. In other words, the fowls are exhausted, and then it is more profitable to kill them. Still, as there is a temporary interest in promoting this increase, two formulas of powders can be used. First Formula: 2 parts of Cayenne pepper, 4 parts of mixed spices, and 6 of ginger. Mix well, and add a spoonful of coffee to each half kilo. Give as food to the poultry two or three times a week; or it may be introduced in fresh meat, minced finely. Second Formula: Pulverize egg shells, 4 parts; pimento in powder, 4 parts; iron sulphate, 4 parts; fenugreek, 2 parts; black pepper, 1 part; sand, 2 parts; powder of dog cake containing meat, 6 parts. A large spoonful of this mixture will answer at one time for 20 fowls.

Practical Experience in the Production and Use of Façade Paints.—The author has found that colors forming only in the paint itself leave nothing to be desired as regards uniformity of shade as well as durability. He also ascertained by practical trials that it is more advantageous to first coat the façade with a purely mineral ground-substance, and only afterward to apply the oil paint or waterglass. This it is true increases the cost, but is fully repaid by the coating being weather-proof, and fast to light and air. For the production of the priming coat are adapted all good fat clays thoroughly frozen out and finely washed, fiucan, or the fat little-colored varieties of the seladonite earth, in short all plastic clay silicates.

These clays are finely levigated, and after the clay mass has settled the water above, it is poured off and the clay paste divided into two equal parts. Separately prepare solutions of those coloring salts, as mentioned below, in such degrees of concentration that about 10 per cent solutions of the salt result, that is to say, in the stoichiometric proportions of weight.

After these solutions have been admixed to the two clay pastes, the two clay masses are allowed to flow together with diligent crutching, whereupon the clay will acquire the shades mentioned below. After decantation it is reinforced as required with size, and the façade surface primed with it. As soon as the coating is air-dry (for this reason the work should be conducted in dry weather; if possible on a sunny day) coat with waterglass or transparent oil varnish.

Blue vitriol and soda give sky blue to leek green, according to the concentration of the two salt solutions. Sugar of lead and red potassium chromide yield a rich yellow. Sugar of lead and yellow potassium chromide or sugar of lead and red potassium chromide together with some lime furnish orange in various gradations. Iron chloride and lime water give a handsome brown. Green vitriol and lime furnish initially a dirty green paint, which very soon passes into pale reddish brown. Nickel sulphate and soda yield a pale green of special delicacy. Manganous sulphate and potassium permanganate produce a magnificent luster-brown.—Communication of the experimental station of Gawalowski at Raitz in Moravia.—Translated from Neueste Erfindurgen und Erfahrungen.

ENGINEERING NOTES.

The use of liquid fuel on board one of the steamers of the Roumanian State Maritime Service in 135 voyages between Constanza and Constantinople has resulted in a saving of 40 per cent in the expenses, and it is expected that oil will be used on all the other boats in the same service.

It is estimated that in Teneriffe there are 100,000 acres of land which are at present sterile, and which, if irrigated, could be devoted to the cultivation of bananas, tomatoes, and potatoes. So far, artificial irrigation has been applied to not quite 20,000 acres, while it is the opinion of experts that if the rain supply in the central elevated portion of the island were accumulated it would suffice to irrigate some 50,000 acres.

Light-buoys using electric light, several of which have been used for some years in New York harbor to mark the ship channel in the lower bay, have now been abandoned, and the power station on Sandy Hook which supplied them with current has been closed. The electric buoys have given more or less trouble, mainly because of damaging and breaking of the supply cables by ice or other causes. They have been replaced by the Pintsch gas buoy.

In the construction of the extension lines of the Metropolitan Railway in Paris a curious engineering problem has presented itself. At the Place de l'Opera three lines of the railway will cross one over the other at three different levels. The presence of water in the subsoil near the surface renders the construction of the tunnels somewhat difficult at this point, and the engineers are solving the problem in a rather paradoxical way. Large cavities about 70 feet deep are being dug in the earth and these filled with great blocks of cement, forming a solid watertight mass. Then the engineers will commence boring their tunnels through the artificial rock sunk by themselves.

The Great Western Railway Company some time ago arranged for the experimental introduction on a portion of their main line west of Swindon of a service of self-contained steam cars. These two cars, which are now nearing completion at the Great Western Company's works at Swindon, are to be shortly introduced to give a regular service between Stonehouse and Chalford, in the Stroud Valley, a distance of about seven miles. A novel feature of the proposed service is that the permission of the Board of Trade has already been obtained for the cars to stop not only at the intermediate stations, but also at certain level-crossings *en route* in order to pick up and set down passengers. At the outset it is intended to give an hourly service in each direction, with the following stopping places: St. Mary's crossing, Brimscombe Station, Ham Mill crossing, Stroud Station, and Downfield and Ebley crossings. The cars, which will be driven by steam and not by petrol, will have an average speed of about 30 miles an hour, and are estimated to cost nearly £5,000 each. They will each hold 52 passengers, and, as the service is only intended to be an omnibus one, there will be but one class. The cars will run on two four-wheeled bogies, one of which carries the engine and driving gear. Should the experiment justify expectations, the principle will, it is stated, be extended to several other sections of the railway.

A. Sandaran, in a recent issue of a Continental contemporary, describes a new method of testing the molecular state of locomotive axles and other iron and steel pieces, this method being based on the magnetic properties of iron and steel, and intended to reveal any injury these pieces possibly have undergone in operation. From the principles of magnetism it is inferred that, when testing an iron or steel piece before commencing work, the graphical representation of a magnetizing cycle will afford an illustration of the magnetical properties of the piece concerned. Now the axles of locomotive and railway carriages, as well as other machine pieces, are exposed in operation to such vibrations and shocks as to become brittle, when the fracture will show a crystalline structure. At the same time the magnetic residual phenomena are diminished, the iron piece assuming the normal average state as corresponding with the magnetic force acting on it much more rapidly, its hysteresis thus being diminished, and the ascending and descending branches of the induction curve differing from one another to no material degree. Between the magnetizing curves of an axle or another iron piece, as recorded at different periods of operation, there may thus be noted important differences, a magnetic investigation of the piece in question allowing of conclusions being made as to its present safety, and of stating whether any abnormal alteration, such as an internal fracture, has occurred.

The frequent cases of land subsidence, especially pronounced during heavy rains, and more or less experienced where extensive coal mining has been carried out, have once more brought to the front the great advantage of steel over iron pipes. The latter have long been universally used, largely because of their cheapness and of the simplicity with which water tightness and gas tightness have been insured. Experience has shown that leakages, if not also breakages, may result from the settlement of the surrounding earth, hence the adoption of steel pipes has become a matter almost of expediency rather than of choice, notably in the case of the producer-gas-distribution scheme throughout the honeycombed district of South Staffordshire in England. The most important first application, however, was in connection with the line of piping for Coolgardie Water Supply in Scotland, which extended for 300 miles inland. In that case one of the considerations was the lighter weight and facility of transport provided by the steel pipes as compared with the thick cast-iron conduits. The experience gained has been all in favor of an extension of the system of steel piping, but the producing capabilities of the country have scarcely been adequate. The only technical difficulty is the forming of the longitudinal joints of the plates forming the pipe and the design of a suitable coupling connection. But the problem has been solved in connection with the Coolgardie scheme and the South Staffordshire gas supply, and it is interesting to note that a large Glasgow concern intends to manufacture pipes up to 48 inches in diameter.

ELECTRICAL NOTES.

After pointing out that with the contact methods so far used no practical result susceptible of an industrial utilization is possible, as the baths used in connection with aluminium contact were always of an acid character, A. Darlay, in the Electrochem, Zeitschrift, suggests employing strongly alkalic baths, aluminium and magnesium being readily attacked by alkalies, solid aluminates being formed.—A. G.

A French incandescent furnace, applicable for the production of cast iron, ferrosilicon, ferromanganese, and like substances, consists of a carbon base, refractory walls, a carbon sill, a carbon block, and a shaft for admitting fuel. The current is supplied through the base and block and passes through coke or other fuel with which the furnace is kept filled through the shaft. The ore is supplied over the sill after being highly heated in an adjacent preparatory furnace—in part by the gases escaping from the electric furnace between the sill and block. The sill acts as a short circuit for the current, thereby producing a very high temperature at its inner edges. Tap holes are provided for the metal and slag. In a modification the walls of the furnace are made of carbon up to the ore inlet, the special sill being dispensed with. The conducting block, vertically arranged in the first, is placed here horizontally and provided with a vertical hole, through which the coke descends into the furnace.

Compound-wound 2-pole overhung dynamo, giving 250 amperes at 200 volts when running at 900 revolutions per minute. The dynamo shaft was carried on two bearings, and fitted at one end with a half coupling to which was bolted another half coupling keyed upon a short shaft supported at the outer end by a third bearing, this last-mentioned half coupling being the boss of the driving pulley. The dynamo was driven by a belt from the flywheel of a horizontal engine with a belt-driven governor. In the absence of the attendant the engine began to race, and attained a speed sufficient to burst the flywheel, one or more of the fragments of which crashed into and wrecked the dynamo irreparably. It was believed by the owners that the pulley on the dynamo shaft broke first, and that the driving belt came off the flywheel and broke the small belt which drove the governor, putting the latter out of action. Had the engine been fitted with a knock-off gear for shutting off the steam when the governor balls fell to their lowest position the breakdown would probably have been prevented. Many firms regard a "knock-off" for slow speed as useless, but this example proves that it is not so.—Mechanical Engineer.

Interesting figures of costs of operating an installation of electric drills were recently given by the general manager of an American mining concern. There were four drills with 2-horsepower, 110-volt, continuous-current portable motors, one drill with 1½-horsepower, 110-volt portable motor, with 7 feet flexible shafts, adjustable tripods, drifting columns, the necessary flexible cables, working tools and five sets of drills of suitable lengths to drill holes varying from 2 feet to 8 feet deep. The figures, published in the Electrical World and Engineer, are as follows: Steam power—One cord of cedar wood, delivered, $2.25; one engineer, $4; lubricants for engine and generator, 35c.; total, $6.60. Operating three drills—Three power-drill men at $4 each, $12; three helpers at $2 each, $6; one blacksmith, $4; one helper, $2; three bushels of charcoal at 25c., 75c.; lubricants, 20c.; total, $24.95. Total cost of running three drills 10 hours, $31.55. The performance by drills used during the season, in advancing and lowering the bed rock cut; averaged 312 feet of holes per 10-hour shift. The performance by two miners drilling by hand, with ⅞-inch steel and 8-pound hammers, averaged about 14 8-10 feet per 10-hour shift, and made the cost of drilling 312 feet of holes in bed rock by hand as follows: 42 miners at $2 per day, $84; one blacksmith, at $4 per day, $4; one helper, at $2 per day, $2; four bushels of charcoal, at 25c., $1; total cost of drilling 312 feet of holes by hand, $91. Saving made in favor of power drills per 10-hour shift, $59.45.

The Massachusetts Agricultural College has been conducting at its Hatch Experiment Station some experiments for the purpose of ascertaining the extent of injuries to shade trees by electricity. The results may be summarized as follows: A considerable amount of damage occurs to shade trees by wires, causing abrasions, destruction of limbs and leaders, burnings, and necessitating much injudicious pruning. The greatest amount of damage caused to trees by alternating and direct currents is by local burnings. The higher the electromotive force (voltage), the more injury is likely to occur to trees. There is practically little or no leakage from wires during dry weather. In wet weather, however, when a film of water is formed on the bark, more or less leakage is likely to occur, and if the insulation is insufficient and contact with the trees exists, grounding takes place, and burning due to arcking results. No authentic cases have been observed where the alternating current, employed for lighting service, has killed trees, though there are authentic cases, extremely rare, where the direct current, used in operating street railroads, has killed large shade trees. This has been accomplished by reversing the polarity, causing the positive current to traverse the rail, and the return current the feed wire, which usually carries the positive. The high resistance offered by trees and plants, in general, serves as a protection against death from an electrical contact. The least resistance in trees occurs in the vital layer (cambium), and those tissues adjacent to it. Electric currents of whatever nature, when applied to plants of a certain intensity, act as a stimulus. The physiological effect of the direct current on vegetable life differs from that of the alternating: the latter current acts more as a stimulus to the plant than the former. There is evidence to support the idea that a current, of not sufficient strength to cause burning, may overstimulate the plant and cause a retardation of its activities which will subsequently result in death. Earth discharges during thunderstorms are more common than generally supposed, and they are known to disfigure and cause the death of trees.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Siberian Railroad Statistics.—The ministry of communications has signed a contract with the International Sleeping Car Company to run weekly, beginning April 14, 1903, five lines of fast trains between Moscow and the terminals of the Siberian Railroad; April 14, 1904, seven lines must be run; January 14, 1905, besides the seven fast trains, special trains de luxe, express, from Moscow to the terminals of the Chinese Eastern Railroad and return and from Moscow to Vladivostock and return. The speed of the trains de luxe between Moscow and Irkutsk must be greater than the speed of the usual "fast trains." For the express trains the International Company will be allowed to charge for first class 2½ cents additional per mile; second class, 2 cents, including the government rate. The company must conform to all custom-house regulations and guarantee baggage and merchandise delivery at house address at an extra charge to be approved of by the railway authorities. This contract will last for twelve years.

The through fast trains began running May 1, with the following rates: First-class tickets, Dalny to St. Petersburg, $138; second-class, $92; 36 pounds of baggage free; overweight charges, $1.37 for every 10 pounds (Russian). The time is now scheduled at fifteen days; the average is seventeen. All fast trains have the movable seat, which serves for sleeper; for these there is no extra charge. Each train includes a dining car, where meals of good quality can be had at an average cost of $1.50 per day; wines, etc., extra. There are two changes between Dalny and St. Petersburg—at Missovaia, eastern side of Lake Baikal, and at Moscow. From Vladivostock there are two additional changes—at Grodekof and at Harbin. From Vladivostock to Grodekof accommodations are good, but from Grodekof to Harbin they are still poor; hence, travelers who want comfort and safety should take the route from Dalny rather than from Vladivostock.

At the present time the through fast trains leave Dalny only once a week—on Sundays. Passengers leaving Vladivostock can only make connection with this fast train at Harbin by leaving here on Tuesdays and Saturdays.

The latest report of the committee of management gives the length of the road as 2,066 miles, and contains the following information regarding the traffic of 1901:

Trains in operation	74,198
Average cars to train	16.54
Passengers carried, all classes (in 1900, 926,976)	1,124,300
Passenger fares	$1,419,187.00
Amount paid for baggage carried	$412,608.00
Average amount paid by each passenger for baggage	$1.53
Amount paid for freight transportation:	
Merchandise (2,409,195 tons)	$7,713,737.00
Average per ton	$3.20
Total income	$9,818,219.00
Total expenses (excluding extra ones)	9,639,763.00
Net profits	$178,456.00
Extra and unforeseen expenses, force majeur	1,218,252.00
Actual deficit	$1,039,796.00
Actual deficit in 1900	1,331,024.00

The income exceeds the estimate by $2,539,209; the total expense exceeds the estimate by $2,293,467; the special expense exceeds the estimate by $672,762; and the deficit exceeds the estimate by $427,020.—R. T. Greener, Commercial Agent at Vladivostock.

Bricklaying in Winter.—The press of this country is calling attention to what is here, at least, a new method of overcoming the obstacle to building operations in winter due to frost. It is averred that in Sweden bricklaying is now carried on without interruption during the long and severe winters. It is probable that the method that makes this possible may be an old story in the United States, but I submit a description of it for what it may be worth.

It has been demonstrated that bricklaying can be carried on in a temperature as low as 16 deg. F. For lower temperatures it is necessary to heat the sand and water used in making the mortar. The heating of the water is easily accomplished, and for the sand the common arrangement consists of a circular iron tube 18 to 24 inches in diameter and 6 to 8 feet long. This is closed at one end with bricks or an iron plate. On the top at this end there is a chimney 8 to 10 feet high and 5 to 6 inches in diameter. The fuel, which is generally refuse wood from the building under erection, is fed in at the open or partly open end of the cylinder. This cylinder is often formed of an old boiler tube or of a piece of an old iron chimney. For burning coal, special grate and chimney arrangements would be necessary, but in no case need they be elaborate or expensive. After placing this cylinder on the ground the sand is heaped on and around it to a depth of 18 to 24 inches and allowed to remain till it gets hot, when it is taken away from where it is hottest and replaced by fresh sand. The mortar should be made in a room where the temperature is kept well above freezing point, and regulated according to the frost to be counteracted. Generally this room is made by roughly boarding in a part of the scaffolding, simplicity and cheapness being desirable. In laying the bricks care should be taken to avoid shifting them after once being set in the mortar, and old or stale mortar should never be used. Fifteen or twenty years ago, where this process is now employed, almost all building was broken off for four or five months during the winter. To-day it is an exception to find it hindered more than a few days or a few weeks annually.—Frank W. Mahin, Consul at Nottingham.

Siberian Butter Trade.—In February there was a convention at Tomsk of those engaged in the butter business in western Siberia. The main point discussed was the method of extending the butter export to Dalny, Port Arthur, and the ports of China. Mr. Sakharoff, representative of the Chinese Eastern Railway, stated that there was a strong and constant demand for Siberian butter in East Asia and China. This demand would certainly increase, and steps must be taken to meet the demand. Hitherto Australian butter had been popular in the Far East, but a series of dry seasons had nearly stopped this export. Siberians must avail themselves of this opportunity and supply the deficiency. The ruling prices in eastern markets were very favorable. Vladivostock consumes annually about 60,000 poods (2,160,000 pounds) of butter at prices ranging from 20 to 24 rubles per pood (30 to 34 cents per pound) and upward. Should prices be lowered and the quality retained, the western Siberian exporters could easily count on a consumption of 300,000 poods (10,833,600 pounds) each year. At Harbin one firm sells at the present time 100,000 poods (3,611,200 pounds). The main thing is for the Chinese Eastern Railway to furnish facilities for the proper transportation of butter to the East, as is already done in the westward transportation. Mr. Sakharoff promised in behalf of the railroad that these facilities would be made—two butter cars (daily) and ice houses at several important stations. While the western traders look with interest to the expansion of their business, the rising butter industry of eastern Siberia will more likely receive the greater advantage from the shorter distance and cheaper freights.—Richard T. Greener, Commercial Agent, Vladivostock.

England's Iron Supply.—The Handels Museum, Austria's official governmental organ, in its issue of July 9, says:

"The English government is giving out information obtained from its consuls covering the world's iron-ore supply. The large import of iron ore into England—about one-third of the total amount consumed—is not due to any fear of the exhaustion of the supply, but to a desire to save the non-phosphorus iron used in the acid process. There is a large, almost unlimited, supply of iron containing phosphorus in Scotland and in the Cleveland and Staffordshire mines. The great anxiety caused by the decrease in the North Spanish supply, particularly in the mines about Bilbao, was somewhat allayed by the discovery of new deposits in the southern parts of the Peninsula; still, the distance of the new mines from the seashore and the high freight rates by sea preclude the possibility of these ever being to England what the mines of Bilbao have been. Great hopes have been placed in the Norwegian mines—those in the polar circle. By a process invented by Edison, these, in spite of the fact that the ore is not rich in iron, may be profitably utilized. The rich mines of northern Sweden are bound by long contracts to pay tribute to the Germans. Just now efforts are being made to buy 2,170,000 tons of iron ore from the Russian mines of Krivoirog at 12s. ($2.92) a ton f. o. b. Nikolajev. The Algerian mines that have not begun to yield a very large supply will be needed by France. Unless Labrador is found to be rich in iron ores, England will have to take thought for to-morrow along certain lines of her iron-ore supply."

Trade Openings in the Argentine Republic.—The Chamber of Commerce Journal, of London, England, says:

"There is an excellent opening in the Argentine Republic, says British Consul Ross, of Buenos Ayres, for all appliances connected with or required in agriculture and grazing—tools, harness, seeds, bags, twine, fencing wire (plain and barbed), iron posts and droppers, gates, padlocks (insets), cattle brands, scales, windmill and other pumps, troughs, pipes, vets' instruments and books, sheath knives, tools, sheet iron, and enameled ware. Probably the Canadian and Australian types would suit better than the British. In a lesser degree, and for the million or so people who live in towns, are wanted, besides the usual necessaries of life, iron pillars and beams for house building, baths, and all kinds of sanitary fittings, electric lifts, lights, and bells, floor and wall tiles, water and oil paints, wall papers, and brickmaking and stone-working machinery. As regards methods of business, the consul says there is no doubt that an expert traveler, with fresh ideas, knowing Spanish, will in almost any line obtain sufficient orders to pay his expenses when a firm of good standing acting as agent will do little or nothing. Too careful attention cannot be given to packing instructions to comply with customers' requirements and to satisfy the fancies of the market. Circulars and price lists are but little attended to even when in Spanish. As regards the selection of goods, constant change and novelty are essentials, and equally so strict adherence to the requirements of the buyer and low prices."

New Dental Gutta-Percha.—In order to obtain in a single preparation the combined properties of gutta-percha and cement, a German, Dr. Emil Herbst, has devised the following method: A given quantity of cement powder is mixed thoroughly with an equal amount of base-plate gutta-percha filings, and into the resulting mixture a small amount of cement liquid is incorporated. This paste becomes thoroughly hard and can be advantageously used in setting crowns and bridges. It becomes soft and malleable when heated, and therefore a bridge set with it can be easily removed. Incidentally, he refers to another method of obtaining a gutta-percha and cement compound, which consists in mixing together equal quantities of cement paste and gutta-percha solution. This combination makes a preparation which easily adheres to the walls of the tooth and becomes slightly soft upon being heated. Dr. Herbst offers these methods as mere suggestions on the possibilities of mixing cement with gutta-percha with the object of obtaining a material possessing the advantages of both, and he says that the results obtained in the few cases in which he has tried the combination would warrant its further trial by the profession.—Oliver J. D. Hughes, Consul-General, Coburg.

Automobile and Bicycle Exposition in Leipzig.—The sixth annual international automobile and bicycle exposition will be held under the auspices of the Society of German Bicycle Manufacturers, at the Crystal Palace, Leipzig, from the 15th to the 21st of October next, both inclusive. This year the exposition will not be confined solely to automobiles and bicycles, but sewing machines, typewriters, cash registers, etc., will also be displayed. It is reported that there is already a great demand for floor space at the exposition, detailed information in regard to which may be obtained by writing to the general secretary, Internationaler Markt und Ausstellung von Motorfahrzeugen, etc., Krystall Palast, Leipzig, Germany. Automobiles are not attaining the popularity in central Germany that they are in France, England, and the United States. Indeed, in this city, which has a population of 500,000, one seldom sees an automobile.—Brainard H. Warner, Jr., Consul, Leipzig.

Iron Exports of Germany.—In 1902 Germany exported 1,000,000 tons of pig iron and partly manufactured iron, at non-paying rates, more than was exported in 1901. In other words, this export trade was conducted at an actual loss. The Dortmund Chamber of Commerce frankly admits that this increase was effected by sacrificing profits—business being occasionally conducted at a dead loss. According to this authority the ironmasters had to choose between selling at a loss, or at best without realizing any profit, or limiting their output, and the former was considered the least of the evils. The chamber says that a matter of far-reaching importance to the future of this industry is that the German materials, thanks to the methods adopted by German exporters, have gained a footing in markets and consuming centers which previously knew them only by name, and which, now convinced of their superior qualities, have made arrangements for the continuation of their imports, provided prices prove satisfactory.—Oliver J. D. Hughes, Consul-General, Coburg.

Canadian Paper Industry.—European papers are publishing interesting comments on Canada's paper production. They say that its resources of raw material for paper-making are practically inexhaustible. A production of fully 1,300,000 pounds every twenty-four hours is looked for in the near future. The present capacity certainly gives promise of this output. These figures include paper of all kinds. The industry is 75 years old, has forty mills, and is turning out a constantly improving quality and quantity. It is meeting foreign competition with more than fair prospects of success. It is succeeding in replacing many foreign grades with the domestic production. Still, imports of the finer kinds of foreign grades are increasing. They amounted to $1,140,000 in 1898 and to $1,950,000 in 1902. The kinds imported are blotting, fine writing, printing, and carpet paper.

Petroleum in Greece.—Minister J. B. Jackson reports from Athens, July 16, 1903, that he is authoritatively informed that the future of the trade in American petroleum in Greece is not in danger, as no other country can compete with the United States either in quality or price. Efforts are being made to induce the government to obtain its supply from other than American sources. It has long been known, continues the minister, that naphtha is to be found in the island of Zante, but past investigations have not led to a belief that the fields could be worked profitably. An English company has now the intention to go into the matter seriously and has been negotiating with the government to that end.

American Locomotives for France.—Consular Agent C. J. King, of Lille, in reporting, July 22, 1903, on the depressed condition of the industries of his district brought about, according to the Lille Chamber of Commerce, by conditions in the United States and the threatened changes in the customs of Germany and Switzerland, says that much local capital is being invested in foreign securities and that, while the local machine and locomotive industry has been anything but prosperous, the railway companies have given many large orders for American locomotives. In the face of such conditions the agent considers it rather strange that Porto Rico should continue to draw the greater proportion of its machines and locomotives from Lille.

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Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

SELECTED FORMULÆ.

To Remove Iron-Rust from Wash Goods.—To remove spots of rust from muslin and white goods generally, saturate them with lemon juice and salt and expose them to the sun. If one application does not remove them entirely, make a second. It is rarely that more than this is required.—Pharmaceutical Era.

Celluloid Varnish.—Digest 2 parts of colorless celluloid with 20 parts of acetone in a close vessel during several days and with occasional shaking, until a clear, thick mass results. This is mixed with 78 parts of amyl acetate and allowed to clarify by subsidence during several weeks.—Pharmaceutical Era.

Liquid Laundry Polish.—The Seifenfabrikant gives the following as a solution for polishing shirt bosoms, collars, etc.:

Gum arabic	4 parts
Borax	5 parts
Glycerin	6 parts
Spermaceti	3 parts
Water	60 parts

Mix.

Piano Polish.—

I.

Gum mastic	65 parts
Shellac	250 parts
Alcohol	1,000 parts

For the finest work, the alcoholic solution of the gums should be shaken with about one-tenth of its volume of benzin, and the latter drawn off after the mixture has been allowed to stand for a few hours. This gives greater mobility.

II.

Egg whites	1½ ounces
Raw linseed oil	8 ounces
Alcohol	2½ ounces
Orchil	½ ounce
Hydrochloric acid	2 ounces
Vinegar	8 ounces

—Drug Circ.

Photographing on Silk.—The silk (China silk is said to be the best) is thoroughly and carefully washed, to free it from dressing, and then immersed in the following solution:

Sodium chloride	4 parts
Arrowroot	4 parts
Acetic acid	15 parts
Distilled water	100 parts

Dissolve the arrowroot in the water by warming gently, then add the remaining ingredients. Dissolve 4 parts of tannin in 100 parts distilled water and mix the solutions. Let the silk remain in the bath for 3 minutes, then hang it carefully on a cord stretched across the room to dry. The sensitizing mixture is as follows:

Silver nitrate	90 parts
Distilled water	750 parts
Nitric acid	1 part

Dissolve. On the surface of this solution the silk is to be floated for 1 minute, then hung up till superficially dry, then pinned out carefully on a flat board until completely dry. This must, of course, be done in the dark room. Print, wash, and tone in the usual manner. A writer in the Chemist and Druggist, some time ago, recommended a mixture of the acetate and sulpho-cyanide toners as giving the best results.—National Druggist.

Straw Hat Varnishes.—For a colorless varnish the following gives excellent results:

1.

Soft Manila copal, clear pieces	450 parts
Sandarac	75 parts
Camphor	7.5 parts
Venice turpentine	40 parts
Alcohol, 95 per cent	800 parts
Castor oil, q. s.	

Mix and dissolve. Of the castor oil very little, not over 20 to 25 drops to the pint of varnish being quite sufficient to give elasticity. It should be added after other ingredients are dissolved.

2.

Sandarac	135 parts
Gum elemi	45 parts
Pine rosin	45 parts
Castor oil	4 parts
Alcohol, 95 per cent	500 parts

Mix the ingredients except castor oil and dissolve, add the oil and dissolve by agitation.

The first of these varnishes is especially designed for white straw, while the other answers for yellow or colored straws. The following, however, are better suited for the heavier colors:

Varnishes to Use With Colors.—

1.

Shellac	50 parts
Sandarac	35 parts
Galipot	45 parts
Soft Manila copal	85 parts
Castor oil	3.5 parts
Alcohol	450 parts

Mix and dissolve as before.

2.

Shellac	500 parts
Sandarac	175 parts
Camphor	18 parts
Venice turpentine	50 parts
Castor oil	15 parts
Alcohol, 95 per cent	2,000 parts

Mix and dissolve as before.

3.

Shellac	75 parts
Rosin	15 parts
Venice turpentine	15 parts
Castor oil	2 parts
Alcohol, 95 per cent	250 parts

Colors Best Suited for Use.—The following are the aniiin colors most used by Vienna hatters: Lemon yellow, violet, eosin red, crystal scarlet, Bismarck brown, brilliant green, "spri" blue and deep black. They are added directly to the varnish and dissolved by agitation. Better results, when large quantities of varnish are to be made up, are achieved by dissolving the colors in the alcohol first.—National Druggist.

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